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NEW COMBINATIONS IN *MONTIOPSIS* KUNTZE (PORTULACACEAE)

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ABSTRACT

New combinations are provided for eighteen species of *Montiopsis*, a South American genus previously treated in *Calandrinia* (Portulacaceae). The nomenclatural changes reflect monographic studies in the group and cladistic data on Portulacaceae.

KEY WORDS: Argentina, Bolivia, Chile, Perú, *Calandrinia*, *Montiopsis*, Portulacaceae, taxonomy

Montiopsis Kuntze (Portulacaceae) comprises ca. eighteen species, in two subgenera (*Montiopsis* and *Dianthoideae*). The plants are annual and perennial herbs, found in Chile and bordering regions of Argentina, Bolivia, and Perú. Species delimitation and relationships in *Montiopsis* have been problematic because of morphological variation and intergradation associated with a variety of arid and Andean habitats. Therefore, I undertook a revision of subg. *Montiopsis* (fifteen species), including investigation of phylogeny and evolution in the group (Ford 1992).

Montiopsis has traditionally (Pax & Hoffmann 1934; McNeill 1974; Nyananyo 1990) been included in *Calandrinia* Kunth. However, Carolin (1987) found that *Calandrinia* sensu lato is polyphyletic and divided it into several genera. He placed *Montiopsis* in *Baitaria* Ruíz & Pavón, with *Calandrinia* sect. *Acaules* Reiche. Hershkovitz (1990, 1991, 1993) showed that *Calandrinia* sect. *Acaules* is allied with *Calandrinia* sensu stricto, but these taxa are only weakly linked to *Montiopsis*. I have adopted his separate circumscription of the genus, necessitating the new combinations presented below.

The most comprehensive previous treatment of *Montiopsis* at the species level is that of Reiche (1898). He attempted to synthesize the numerous epithets described for Chilean taxa by Hooker & Arnott (1833), Barnéoud (*in* Gay 1847), and Philippi (summarized by Muñoz 1960). Reiche treated *Montiopsis* subg. *Montiopsis* as *Calandrinia* subg. *Hirsutae* Reiche (sects. *Hirsutae*,

Condensatae, and *Parviflorae*) and recognized *Montiopsis* subg. *Dianthoideae* as a section in *Calandrinia* subg. *Glabrae* Reiche.

Añón (1953, 1984) and Peralta (1988) included Argentinian species of *Montiopsis* in their floristic treatments. My monograph (Ford 1992) is based on extensive literature, herbarium, greenhouse, laboratory, and field studies, conducted to unify prior disparate taxonomies. The taxa accepted here synthesize previously published information and new data gathered during my project.

Montiopsis Kuntze, *Rev. Gen. Pl.* 3(2):14. 1898. TYPE: *Montiopsis boliviana* Kuntze (=*Montiopsis cumingii* [Hook. & Arn.] D.I. Ford). BOLIVIA. Oruro: Challapata, 18°54'S 66°48'W, (11 Mar 1892), *Kuntze s.n.* (HOLOTYPE: NY; Isotype: CONC-73586).

MONTIOPSIS SUBG. *MONTIOPSIS*

Montiopsis subg. *Montiopsis* (=*Calandrinia* subg. *Hirsutae* Reiche, Ber. Deutsch. Bot. Ges. 15:502. 1897.).

The fifteen included species are pubescent (and sometimes glandular) annuals and perennials, with pantoporate pollen.

Montiopsis berteroana (Phil.) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia berteroana* Phil., Linnaea 28:643. 1856. TYPE: CHILE. O'Higgins (VI). Prov. Cachapoal: Tagua-tagua, 34°30'S 71°06'W, Oct 1828, *Bertero s.n.* (LECTOTYPE [here designated]: SGO-48659 [bottom plant]; Probable isolectotypes: BM,MO-*p.p.*,P-*p.p.*). The SGO sheet contains five plants and three labels. The lowermost specimen is nearest to the Bertero label and is one of the two plants which are branched and have fruit, in accordance with the diagnosis. The apparent duplicate sheets are numbered *535*, and the P label lacks a date.

Montiopsis capitata (Hook. & Arn.) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia capitata* Hook. & Arn., Bot. Misc. 3:334. 1833. TYPE: CHILE. Cordillera, (1831), *Cuming 247* (LECTOTYPE [here designated]: K [photo-MO]; Isolectotypes: E-2 sheets [photo-A,MO,SGO], K [photo-MO]). This is the best collection of the syntypes at K annotated by Hooker as *C. capitata*. The K duplicates are mounted on the same sheet: the lectotype is marked Herb. Hooker; the isolectotype is marked Herb. Bentham.

Montiopsis copiapina (Phil.) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia copiapina* Phil., Anales Mus. Nac. Santiago de Chile 8:25. 1891. TYPE: CHILE. Atacama (III). Prov. Chañaral: Pastos Largos, 26°35'S 69°03'W, 4000 m, (6 Jan 1885), *F. Philippi s.n.* (LECTOTYPE [here designated]: SGO-48505 [photo-MO]; Isolectotypes: LP SGO-38973 [photo-F UC] 48507).

Montiopsis cumingii (Hook. & Arn.) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia cumingii* Hook. & Arn., Bot. Misc. 3:334. 1833. TYPE: CHILE. (1832), *Bridges 427* (LECTOTYPE [here designated]: K (*427*) [photo-MO]; Isolectotypes: BM,E). The three syntypes belong to two species, and the protologue is ambiguous. The lectotypification made here accords with two of the syntypes and best preserves current usage of names (the other syntype belongs in *Montiopsis demissa).* The collection number on the K sheet is apparently miswritten.

Montiopsis demissa (Phil.) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia demissa* Phil., Linnaea 28:644. 1856. TYPE: CHILE. "mixed with plants from Antuco," (Jan 1839), *Gay* (*1414*) (HOLOTYPE: SGO-48603 [photo-UC]; *non typus*-P). The Paris specimen is the type of *Montiopsis glomerata.*

Montiopsis gilliesii (Hook. & Arn.) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia gilliesii* Hook. & Arn., Bot. Misc. 3:333. 1833. TYPE: CHILE. Cordillera, *Cuming 218* (LECTOTYPE [here designated]: K [photo-MO]; Isolectotypes: BM,E-2 sheets [photo-A],F,GH).

Montiopsis glomerata (Phil.) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia glomerata* Phil., Linnaea 28:643. 1856. TYPE: CHILE. "mixed with plants from Antuco," *Gay* (*1414*). (HOLOTYPE: P; Non typus-SGO). This specimen was determined as *Calandrinia capitata*, but the distinctive dense white trichomes make it a clear match for the protologue. The specimen at SGO is the type of *Calandrinia demissa.*

Montiopsis modesta (Phil.) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia modesta* Phil., *Fl. Atacam.* 20. 1860. TYPE: CHILE. Antofagasta (II). Prov. Antofagasta: Río Frío, 25°05'S 69°05'W, (Feb 1854), *Philippi s.n.* (HOLOTYPE: SGO-48661). This specimen is identified on the label by Philippi as "*C. frigida* Ph." [non Barnéoud]; there is a loose paper in the packet with his *Calandrinia modesta* determination.

Montiopsis parviflora (Phil.) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia parviflora* Phil., Anales Univ. Chile 85:317. 1894. TYPE: CHILE. Coquimbo (IV). Prov. Elqui: Paihuano, 30°01′S 70°25′W, *Peralta s.n.* (LECTOTYPE [here designated]: SGO-48623; Isolectotypes: SGO-38946 [photo-F,UC] 78208).

Montiopsis potentilloides (Barnéoud) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia potentilloides* Barnéoud *in* Gay, *Fl. Chile* [*Hist. Fisica y Politica de Chile, Botanica*] 2:512. 1847 ("1846"). TYPE: CHILE. Coquimbo (IV). Prov. Coquimbo, *Gay 964* (LECTOTYPE [here designated]: P [photo-MO]; Isolectotypes: G,NY,P). The lectotype sheet is annotated by Barnéoud. All the duplicates lack locality information except the G specimen.

Montiopsis ramosissima (Hook. & Arn.) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia ramosissima* Hook. & Arn., Bot. Misc. 3:334. 1833. TYPE: CHILE. Valparaíso (V). Prov. Valparaíso: Valparaíso, 33°03′S 71°38′W, *Cuming 730* (HOLOTYPE: K-neg. 1139 [photo-MO]; Isotypes: CONC,E [photo-A,SGO],F-fragment,W [F neg. 30111]).

Montiopsis sericea (Hook. & Arn.) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia sericea* Hook. & Arn., *Bot. Misc.* 3:334. 1833. TYPE: CHILE. Valparaíso (V). Prov. San Felipe: Sierra Bella Vista, 32°43′S 70°46′W, 1832, *Bridges 111* (LECTOTYPE [here designated]: K-Hooker herb.; Isolectotypes: BM,E,F,K-Bentham Herb.,W [F neg. 30113]).

Montiopsis trifida (Hook. & Arn.) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia trifida* Hook. & Arn., *Bot. Misc.* 3:333. 1833. TYPE: CHILE. Valparaíso (V). Prov. Valparaíso: Valparaíso, 33°03′S 71°38′W, *Cuming 422* (LECTOTYPE [here designated]: K-neg. 1190 [photo-MO]; Isolectotypes: E-2 sheets). This is the best syntype found at K annotated by Hooker as *Calandrinia trifida.*

Montiopsis umbellata (Ruíz & Pavón) D.I. Ford, *comb. nov.* BASIONYM: *Talinum umbellatum* Ruíz & Pavón, *Syst. Veg. Fl. Peruv. Chil.* 117. 1798. TYPE: CHILE. Bío-Bío (VIII). Prov. Concepción: Concepción, 36°49′S 73°03′W, Nov-Jan (1778-1788), *Ruíz & Pavón s.n.* (LECTOTYPE [here designated]: MA). This is the only specimen of the syntypes with the locality specified.

Montiopsis uspallatensis (Phil.) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia uspallatensis* Phil., Anales Univ. Chile 85:307. 1894. TYPE: ARGENTINA. Prov. Mendoza. Depto. Las Heras: Termas del Inca, 32°49′S 69°55′W, "1891" (15 Jan 1886), *Borchers s.n.* (HOLOTYPE: SGO-48500 [photo-UC]). The expedition by Borchers (and F. Philippi)

was in 1885-1886, and the specimens were distributed in 1891; this perhaps explains the erroneous collection date cited in the protologue.

MONTIOPSIS SUBG. *DIANTHOIDEAE* (REICHE) D.I. FORD

Montiopsis subg. **Dianthoideae** (Reiche) D.I. Ford, *stat. nov.* BASIONYM: *Calandrinia* sect. *Dianthoideae* Reiche, Ber. Deutsch. Bot. Ges. 15:501. 1897. LECTOTYPE (here designated): *Calandrinia cistiflora* Gillies *ex* Arn. *in* Cheek, Edinburgh J. Nat. Geogr. Sci. 1:355. 1831.

This group consists of ca. three glabrous or glandular perennial species, with tricolpate pollen.

Montiopsis andicola (Gillies) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia andicola* Gillies *in* Hook. & Arn., *Bot. Misc.* 3:332. 1833. TYPE: ARGENTINA. "eastern side of the Cumbre" and Chile. Valparaíso (V). Prov. Los Andes: Alto de la Laguna, 32°49′S 70°09′W, *Gillies s.n.* (HOLOTYPE: K-neg. 1189 [photo-A,LP,SGO].

Montiopsis cistiflora (Gillies *ex* Arn.) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia cistiflora* Gillies *ex* Arn. *in* Cheek, Edinburgh J. Nat. Geogr. Sci. 1:355. 1831. TYPE: ARGENTINA. "Andes of Mendoza" and Chile, 2743-3048 m, (Mar 1826), *Gillies s.n.* (LECTOTYPE [here designated]: E-GL; Isolectotypes: E,K [photo-SGO]).

Montiopsis gayana (Barnéoud) D.I. Ford, *comb. nov.* BASIONYM: *Calandrinia gayana* Barnéoud *in* Gay, *Fl. Chile* [*Hist. Fisica y Politica de Chile, Botanica*] 2:503. 1847 ("1846"). TYPE: CHILE. O'Higgins (VI). Prov. Colchagua: Talcaregue, Valle del Azufre, (Feb 1831), *Gay 83* (LECTOTYPE [here designated]: P; Isolectotype: P). Both P sheets are annotated by Barnéoud; the locality information on the lectotype matches most completely that given in the protologue.

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CALANDRINIA CAROLINII: NEW NAME FOR *BAITARIA ACAULIS* RUIZ & PAVON (PORTULACACEAE)

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ABSTRACT

Calandrinia carolinii is proposed as the new name for *Baitaria acaulis* Ruíz & Pavón. The latter has historically been confused with *Calandrinia acaulis* Kunth *in* H.B.K., which it closely resembles.

KEY WORDS: Argentina, *Baitaria*, Bolivia, *Calandrinia*, Chile, Colombia, Guatemala, Ecuador, México, Perú, Portulacaceae, Venezuela

The central Andean species *Calandrinia carolinii* (Portulacaceae), formerly *Baitaria acaulis* Ruíz & Pavón has historically been confused with *Calandrinia acaulis* Kunth. Both taxa belong to *Calandrinia* sect. *Acaules* Reiche, which includes ca. eight species of acaulescent perennial herbs with solitary, axillary flowers (Hershkovitz 1993a). Within this group, *C. carolinii* and *C. acaulis* share uniquely a pair of foliaceous bracts subtending the flower.

Calandrinia carolinii was among the first calandrinias ever described, but, falling victim to accidents and oversights, it subsequently vanished from taxonomic knowledge of the Andean flora. At present, we are unable to resolve definitively the systematics of *Calandrinia carolinii*, but research published elsewhere (Hershkovitz 1993a, 1993b) requires a name for plants presumably distinct from the type of *Calandrinia acaulis* and more coincident with the protologue and illustration of *Baitaria acaulis*. In the absence of complete systematic data, we believe that renaming *Baitaria acaulis* as *Calandrinia carolinii* provides the appropriate solution to this problem. The epithet honors Roger Carolin for calling this problem to our attention, as well as for his

milestone contributions to phylogenetic understanding of *Calandrinia* sensu lato and other Portulacaceae.

TAXONOMIC BACKGROUND

Ruíz & Pavón (1794: 63; pl. 36) proposed the generic name *Baitaria* for a Peruvian acaulescent perennial with, among other features, solitary, axillary flowers subtended by two foliaceous bracts and 14-19 stamens. Ruíz & Pavón (1798: 111) subsequently supplied the combination *B. acaulis* for this species, and also described, under *Talinum* Adans., four additional species of Portulacaceae. In a contemporary work officially published much later (see Stafleu & Cowan 1983: 984), Ruíz & Pavón (1957: 145) specified that the fruit of *B. acaulis* was membranous.

Kunth (*in* Humboldt, Bonpland, & Kunth 1823, 6:78) described the genus *Calandrinia* and included therein two species: *C. caulescens* Kunth and *C. acaulis*. The latter, from Ecuador, was similar to *Baitaria acaulis* but had only six stamens. *Calandrinia* subsequently became a conserved generic name with the conserved type *C. caulescens* (= *C. ciliata* [Ruíz & Pavón] DC.).

Candolle (1828: 358-359) recombined Ruíz & Pavón's four *Talinum* species under *Calandrinia*, but he listed *Baitaria* as a synonym of *Calandrinia* without listing *B. acaulis* as a synonym of *C. acaulis* or any other species. Subsequent workers (*e.g.*, Añón 1953; Macbride 1937) followed Candolle on both accounts.

Añón (1953: 7), citing Weddell (1861: pl. 89a), referred Argentinian plants with 25-30 stamens to *Calandrinia acaulis*. We have found that such plants have indurate, rather than membranous capsules, and we have not found more than 20 stamens in any specimen. Weddell's illustration (without description) of *C. acaulis* from Bolivia shows ca. 18 stamens and is similar to Ruíz & Pavón's illustration of *Baitaria acaulis*. Añón referred Argentinian plants with ca. eight stamens to *C. saltensis* Hauman. Such plants, including a syntype of this species (see below), have membranous capsules (pers. obs.).

Prior to our research, two other taxonomists independently discovered the disparate identities of plants referred to *Calandrinia acaulis*, but neither published their findings. The late A.W. Hill, in a handwritten manuscript (ca. 1930) deposited at Kew, recognized that *Baitaria acaulis* and *C. acaulis* were based on different types. He described as distinct from *C. acaulis* three Bolivian/Peruvian species: "*C. mandonii*" ined., "*C. funiculata*" ined., and "*C. mcleanii*" ined., with 10, 15, and 10, stamens, respectively. Hill described the first two species as having indurate capsules but did not specify capsule texture in the last. Hill did not examine type material of, nor specify which species corresponded to, *B. acaulis*. Roger Carolin (pers. comm. to D.I. Ford 1987), noted that one putative syntype of *B. acaulis* (at BM) included both indurate and membranous capsuled plants, while another (at MA) had membranous

capsules only. Hence, Carolin proposed the epithet "*crassa*" for indurate capsuled plants and believed that *B. acaulis* and *C. acaulis* were synonyms. We have determined, however, that the BM specimen is not original material; we have not seen the supposed syntype from Madrid. A *bona fide* syntype in Paris, however, has a membranous capsule (S. Barrier, pers. comm.).

DISCUSSION

Perhaps the most important factor in the taxonomic disappearance of Ruíz & Pavón's plant is Kunth's apparently fortuitous choice of the same epithet for a very similar plant. The subsequent conservation of *Calandrinia* might also have diverted attention from older generic combinations, although Ruíz & Pavón are duly credited with all other accepted epithets recombined in *Calandrinia* see, *e.g.*, Macbride 1937: 569-572). We speculate that the similarities of *C. acaulis* and *Baitaria acaulis* bolstered erstwhile suppositions that the two were the same. Yet, the type localities and type diagnoses are clearly distinct.

Renaming *Baitaria acaulis* is justifiable on nomenclatural grounds alone and is not contingent upon species identities. Nonetheless, we tentatively assign plants with more than 10 stamens, including many with indurate capsules, to *Calandrinia carolinii*. Indurate capsules characterize specimens with 12-20 stamens from Argentina, but only membranous capsules characterize specimens with 5-8(-10) stamens from Argentina, Chile, Colombia, Ecuador, Guatemala, México, and Venezuela. Unfortunately, contrary and intermediate specimens occur in Bolivia and Perú, and we have found only 5-12 stamens in plants from Perú, Ruíz & Pavón's description and illustration notwithstanding. These data suggest that the plants with indurate fruits and higher stamen numbers may represent a new species, in which case *C. carolinii* may be of hybrid origin. It also remains possible that the syntypes of *C. carolinii* are mixed species: Ruíz & Pavón (1794, 1798, 1957) listed three original localities.

CONCLUSIONS

The name *Calandrinia acaulis* Kunth has been historically applied to include the similar and substantially sympatric species *Baitaria acaulis* Ruíz & Pavón, which we are renaming *C. carolinii*. We interpret the last to include plants with 12-20, rather than 5-10, stamens. Future analysis of type material should confirm this judgment or, alternatively, indicate that *C. carolinii* is conspecific with *C. acaulis*, and that plants with indurate rather than membranous capsules represent a new species. In either case, we are justified in renaming *B. acaulis* as *C. carolinii* on clear nomenclatural grounds as well as obvious distinctions between the description of this species and that of *C. acaulis*.

Our provisional taxonomy of *Calandrinia acaulis* and *C. carolinii* is as follows:

Calandrinia acaulis Kunth *in* H.B.K. var. *acaulis*, *Nov. Gen. Spec.* 6:78. 1823.

Calandrinia megarhiza Hemsl., *Diagn. Pl. Nov. Mex.* 23. 1879. *Lewisia megarhiza* (Hemsl.) MacBryde, J. Scott. Rock Gard. Club 13:295. 1973. *Oreobroma megarhizum* (Hemsl.) Standl. & Steyerm., Publ. Field Mus. Nat. Hist., Bot. Ser. 23:49. 1944.

Calandrinia saltensis Hauman, Anales Mus. Nac. Buenos Aires 32:437. 1925.

Oreobroma mexicanum Rydb., N. Amer. Fl. 21(4):326. 1932.

REPRESENTATIVE SPECIMENS: ARGENTINA. Salta: *Venturi 7017* (US); *Rodríguez 1321* (US; SYNTYPE of *Calandrinia saltensis* Hauman).
BOLIVIA. La Paz: *Asplund 6289* (US).
CHILE. Tarapaca: *Ford & Arancio 769* (MO).
COLOMBIA. Caldas: *Cuatrecasas 23184* (F).
ECUADOR. Pichincha: *Heilborn 231* (US).
MEXICO. México: *Beaman 1881* (F).
PERU. Huancavelica: *Stork & Horton 10843* (F).
VENEZUELA. Mérida: *Steyermark 55885* (F).

In our opinion, *Calandrinia acaulis* var. *acaulis* includes *C. megarhiza* (Central America; including synonyms – see Kelley & Swanson 1985) and *C. saltensis* (Argentina). The last two were described as having membranous capsules and, respectively, 5 and 8-10 stamens. *Calandrinia acaulis* var. *magna* J.F. Macbride has been applied to especially large plants from Perú, and otherwise remains unaffected by our proposals.

Calandrinia carolinii Hershkovitz & D.I. Ford, *nomen. nov.* BASIONYM: *Baitaria acaulis* Ruíz & Pavón, *Syst. Veg. Fl. Peruv. Chil.* 111. 1798. [*Fl. Peruv. Prodr.*, 63, tab. 36. 1794], non *Calandrinia acaulis* Kunth.

REPRESENTATIVE SPECIMENS: ARGENTINA. Salta: *Venturi 7018* (US).
BOLIVIA. La Paz: *Mandon 1002* (P).
PERU. Lima: *Macbride 2981* (F); *Pavón 36* (P; SYNTYPE).

As noted above, *Calandrinia acaulis* as applied to plants in Argentina (*e.g.*, Añón 1953) refers to plants with the higher stamen number, hence to *C. carolinii* or a new species. These plants are not, in any case, *C. acaulis*.

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Phytologia (April 1993) 74(4):284-285.

OFTIACEAE, A NEW NAME FOR A FAMILY OF MAGNOLIOPHYTA

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ABSTRACT

Oftiaceae is proposed as a new name for the illegitimate Spielmanniaceae J.G. Agardh, a name in current use whose proposed conservation was not accepted.

KEY WORDS: Magnoliophyta, Spielmanniaceae, Oftiaceae, nomenclature

Reveal & Hoogland (1992) recently proposed eight vascular plant family names in current use for conservation. The Committee for Spermatophyta (Brummitt, pers. comm.) has decided not to adopt Abietaceae (1820) over Cedraceae (1818) or to conserve the illegitimate Dulongiaceae (1858) over Phyllonomaceae (1905). Another illegitimate name that will not be conserved is Spielmanniaceae. As this name is used currently (Takhtajan 1987), the following new family name is proposed:

Oftiaceae Takhtajan & Reveal, *fam. et stat. nov.* validated by the Latin description of Verbenaceae subtribe Spielmanninae J.C. Schauer, *Prodr.* 11:525. 1847 (as "Spielmanneae"), *nom. illeg.* - TYPE: *Oftia* Adanson (1763).

Syn: Spielmanniaceae J.G. Agardh, *Theoria Syst. Pl.* 194. 1858, *nom. illeg.* - TYPE: *Spielmannia* Medikus (1775), *nom. illeg. superfl.* (Art. 63.1) = *Oftia* Adanson (1763).

ACKNOWLEDGMENT

Thanks are extended to R.C. Barneby and B.E. Dutton for reviewing the manuscript.

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Phytologia (April 1993) 74(4):286-288.

A NEW SPECIES OF *STEVIA* (ASTERACEAE, EUPATORIEAE) FROM CHIHUAHUA, MEXICO

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ABSTRACT

A new species, **Stevia martinii** B.L. Turner, is described from a single collection obtained along the upper headwaters of the Río Mayo in Chihuahua, México. It is closely related to *S. glandulosa* but is readily distinguished by a number of features. An illustration of the new taxon is presented.

KEY WORDS: Asteraceae, Eupatorieae, *Stevia*, México

Routine identification of Mexican Asteraceae has revealed the following novelty.

Stevia martinii B.L. Turner, *sp. nov.* Fig. 1. TYPE: MEXICO. Chihuahua: Cardamena barranca, on Río Basaseachic (headwaters of Río Mayo), 6,000 ft, 14 Jun 1984, *P.S. Martin s.n.* (HOLOTYPE ARIZ!).

Steviae glandulosae Hook. & Arn. similis sed foliis crassioribus deltoideis vel subcordatis 1.0-1.3 plo longioribus quam latioribus (vs. diverse ovatis 1.9-3.0 plo longioribus quam latioribus), corollarum lobis dense pilosis (vs. sparsim pilosis vel glabris), et setis pappi 2-4 (vs. setae carens) differt.

Perennial suffruticose herbs or subshrubs to 30 cm high. Stems densely glandular villous with spreading hairs. Leaves opposite throughout, those at midstem mostly 4.0-5.5 cm long, 2-4 cm wide; petioles 1.5-2.0 cm long, pubescent like the stems; blades deltoid to subcordate, ca. as long as wide, glandular punctate and puberulous beneath, especially along the major veins, the margins crenulate. Heads numerous, arranged in congested terminal corymbs 3-6 cm across, 2-3 cm high. Involucres 5-6 mm high, pubescent with both

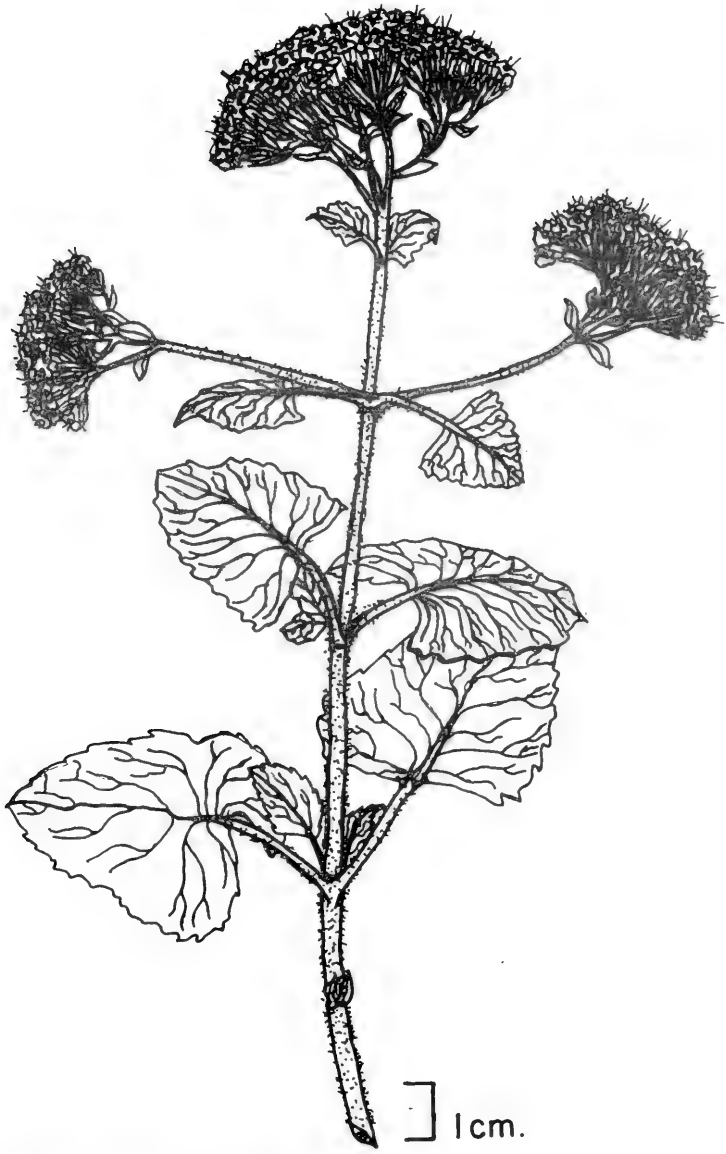

Fig. 1. *Stevia martinii*, from holotype.

glandular and eglandular spreading pilose hairs 0.15-0.25 mm long, the bracts with acute to acuminate apices. Corollas white or pale pink, ca. 6 mm long, the lobes 1.0-1.5 mm long, densely pilose externally. Achenes ca. 4 mm long, glabrous or nearly so (a few minute hispidulous hairs near the apex), the pappus of 2-4 awns 3-4 mm long, below these a low crown of scales ca. 0.4 mm high.

This taxon belongs to the *Fruticosae* series of *Stevia* as delimited in Grashoff's (1972) doctoral treatment, where it will key with difficulty to *Stevia glandulosa* Hook. & Arn. It is readily distinguished from the latter by its thicker, broader, deltoid to subcordate leaves, the blades ca. as wide as long (vs. variously ovate and 1.5-2.5 times as long as wide), densely pilose corolla lobes (vs. very sparsely pilose), and achenes with well defined bristles (vs. absent).

It is a pleasure to name this taxon for its only known collector, Dr. Paul Schultz Martin, Research Associate, Geochronology Laboratories, University of Arizona. He has made numerous important plant collections in northwestern México.

ACKNOWLEDGMENTS

I am grateful to Guy Nesom for the Latin diagnosis, and to him and Carol Todzia for reviewing the paper.

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Phytologia (April 1993) 74(4):289-292.

A NEW SPECIES OF *BULBOPHYLLUM* THOUARS, SECTION *OXYSEPALUM* (ORCHIDACEAE) FROM AUSTRALIA

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ABSTRACT

A new species of *Bulbophyllum* is described for the forthcoming orchid volume of the Flora of Australia.

KEY WORDS: *Bulbophyllum, Oxysepalum*, Queensland, Australia, Orchidaceae

INTRODUCTION

The section *Oxysepalum* Schltr. in the genus *Bulbophyllum* Thouars in Australia contains five species (Gray & Jones 1989). A new species which has affinities with *B. shepherdii* (F. Muell.) H.G. Reichb. is described here as new.

Bulbophyllum lamingtonense D. Jones, *species nova*. TYPUS: AUSTRALIA. Queensland: Moreton District: Lamington National Park, McPherson Ranges, 12 May 1989, *C.W. Harman s.n.* (*D.L. Jones 4042*) (HOLOTYPUS: CBG; Isotypus: BRI).

Species nova affinis *Bulbophyllum shepherdii* (F. Muell.) H.G. Reichb. a qua caulibus pendentibus; pseudobulbis, foliis et floribus majoribus; floribus cremeis; sepalorum apicibus aureis; et labello brunneis marginibus prominenter plicatis, differt.

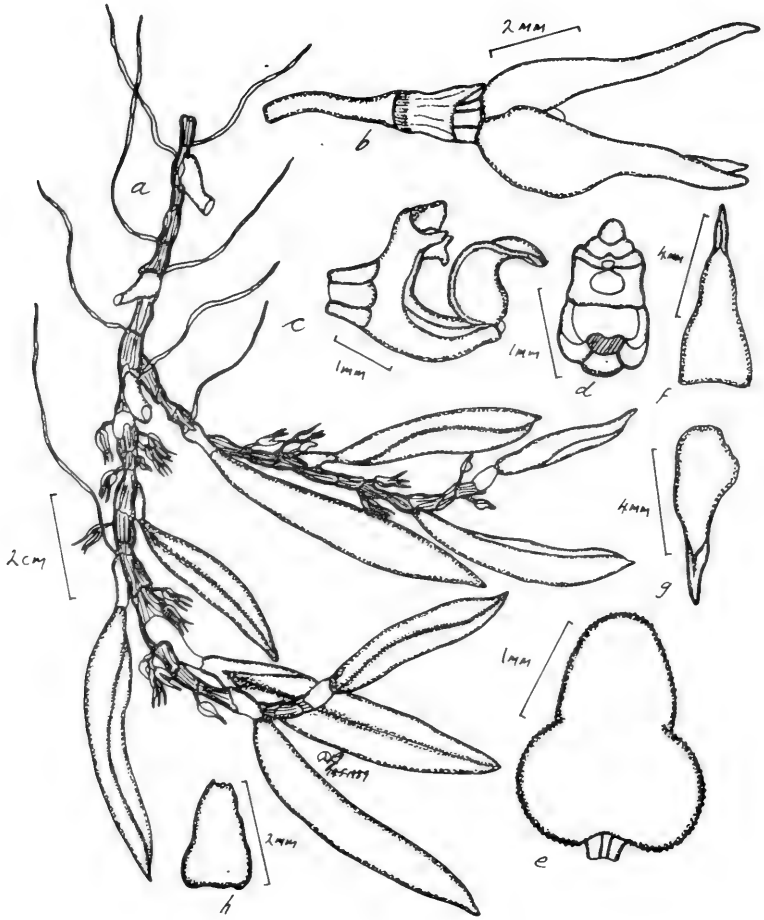

Figure 1. *Bulbophyllum lamingtonense*, Lamington National Park, *D.L. Jones 4042*; a. plant; b. flower from side; c. column and labellum from side; d. column from front; e. labellum from above, flattened out; f. dorsal sepal; g. lateral sepal; h. petal. All figures to indicated scale.

Epiphyte or lithophyte, consisting of a few pendulous unbranched stems to about 20 cm long, the tips upturned. Roots wiry, arising mainly from proximal nodes. Rhizomes ca. 4 mm diameter, covered by brown, scarious bracts, 15-22 mm between pseudobulbs. Pseudobulbs ovoid-conical, 8-12 mm × 2.5-3.5 mm, light green, sulcate on underside, decurrent. Leaf lamina 2-7 cm × 6-14 mm, ellipsoid to obovoid, sessile to subsessile, moderately thick and leathery, midrib sunken on adaxial surface, abaxial surface completely smooth, yellow green to dark green, subacute to obtuse. Pedicels ca. 3 mm long, straight or slightly curved. Ovary ca. 2 mm long. Floral bracts ca. 3 mm × 3 mm, ovate, brown, membranous, closely sheathing. Flowers ca. 6.5 mm long, solitary or in small groups at nodes, cream with yellow tips, sepals spreading to ca. 3.2 mm apart at the tips. Dorsal sepal ca. 7 mm × 1.3 mm, narrowly deltoid, fleshy, obliquely erect, slightly incurved in distal quarter, cymbiform at apex. Lateral sepals ca. 7 mm × 1.2 mm, asymmetrically lanceolate, porrect, parallel or slightly divergent, fleshy, cymbiform at apex. Petals ca. 2 mm × 1.3 mm, ovate, porrect, translucent, distal margin irregular. Labellum ca. 22 mm × 18 mm when flattened, more or less ovate in outline, brown, fleshy, distinctly trilobed, erect in proximal half then projected forwards, margins folded, smooth to slightly papillate, apex recurved, broadly obtuse, margins papillate. Column ca. 1.3 mm long; wings ca. 0.4 mm long, linear-tapered, obtuse, incurved near the apex; foot ca. 1.5 mm long, tapered, slightly curved. Anther cap ca. 0.6 mm × 0.5 mm, white, with a deflexed rostrum. Pollinarium ca. 0.4 mm × 0.4 mm; pollinia ca. 0.4 mm long, in 2 unequal pairs, orange, waxy. Stigma ca. 0.3 mm × 0.2 mm, ovate, sunken. Capsule not seen.

Specimens Examined: Queensland: Moreton District: Green Mountains, Lamington Plateau, 3 November 1992, *J. Roberts s.n.* (*D.L. Jones 10600*) (CBG).

Distribution and Habitat: Apparently restricted to high altitudes in the McPherson Ranges of southeastern Queensland, but possibly occurring in similar habitats in northeastern New South Wales. It grows on small trees and rocks close to escarpments in rainforest and rainforest margins.

Flowering Period: April to August.

Notes: *Bulbophyllum lamingtonense* is closest to *B. shepherdii* (F. Muell.) H.G. Reichb. but can be distinguished by its pendulous stems, larger leaves, larger pseudobulbs and larger flowers which are cream with yellow tips on the sepals and a brown labellum with prominently folded margins. By contrast *B. shepherdii* has nonpendulous stems attached throughout to the substrate, smaller leaves and pseudobulbs and smaller, somewhat shiny, translucent white flowers with yellow tips on the sepals and an orange labellum which has flat margins.

The new species grows in humid situations close to escarpments where there is abundant air movement.

Conservation Status: *Bulbophyllum lamingtonense* is of restricted dis-

tribution but is conserved in Lamington National Park.

Etymology: From the type area of the Lamington Plateau.

ACKNOWLEDGMENTS

I wish to thank Colin W. Harman for bringing this species to my attention and John Roberts for information and extra material. I also thank Alex George for the Latin diagnosis, Mark Clements and Alec Pridgeon for reading the manuscript and Corinna Broers for technical assistance.

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Phytologia (April 1993) 74(4):293-295.

LEUCOPHYLLUM ALEJANDRAE (SCROPHULARIACEAE), A NEW GYPSOPHILIC SPECIES FROM NUEVO LEON, MEXICO

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ABSTRACT

Leucophyllum alejandrae, *sp. nov.*, is described from a gypseous area in southcentral Nuevo León. It produces linear, concolorous leaves with stipitate glandular hairs protruding through the dense, close, greenish silver eglandular vestiture of branched hairs. It is apparently most closely related to another locally endemic gypsophile, *L. hintoniorum*, which has similar vestiture.

KEY WORDS: *Leucophyllum*, Scrophulariaceae, México

Leucophyllum alejandrae Nesom, *sp. nov.* TYPE: MEXICO. Nuevo León: Mpio. Galeana, S of San Antonio de Texas, scattered on gypsum hillside, 1675 m, 19 Aug 1992, *Hinton et al. 22321* (HOLOTYPE: TEX; Isotypes: ENCB,GH,MEXU,NY, and US, to be distributed).

Leucophyllo hintoniorum Nesom similis praesertim foliis concoloris ac vestimento glanduloso sed corollis minoribus foliis brevioribus anguste linearibusque differt.

Alternately branched, nonthorny shrubs ca. 0.6 m tall. Silvery vestiture completely obscuring the stem, leaf, and calyx surfaces, of a dense layer of relatively uniform dendritic trichomes on short stipes (less than 0.1 mm high) or estipitate; young organs densely invested with prominent stipitate glands on uniseriate stipes 0.2-0.4 mm long and extending above the dendritic vestiture. Leaves alternate, densely crowded along the stem, entire, epetiolate, linear or slightly broadened near the apex, 15-21 mm long, 2-3 mm wide, often strongly folded along the midvein. Flowers on densely invested pedicels 1-2 mm long; calyces 5-6 mm long, the lobes lanceolate, cut to within 0.5 mm of the base, 1.0-1.2 mm wide, sparsely glandular inside but without dendritic

hairs; corollas purple, with yellow spots on the lower tube, 13-15 mm long, tube broadly ampliate, to 5-6 mm wide at the throat (pressed), sparsely pilose on inside floor with crinkled hairs, sparsely stipitate glandular on the outside, the lobes obovate, subequal, ca. 6 mm long and wide, emarginate, eciliate, nearly glabrous inside; stamens 4, anthers and filaments glabrous; styles sparsely pilose; ovaries sparsely glandular. Capsules oblong 4-5 mm long, sparsely pilose glandular. Known only from the type collection.

The new species is named for Dra. Alejandra Hinton, physician and lovely wife of George Hinton (the second). She provides a strong motive force, and anchor, for the family.

Leucophyllum alejandrae shares with *L. hintoniorum* Nesom a silvery green vestiture, densely and evenly developed on both sides of the leaf, of short stipitate, dendritic trichomes with stipitate glandular trichomes extending above the basal layer. Together with *L. flyrii* B.L. Turner, these are the only species in the genus with a glandular vestiture, and they almost certainly are closely interrelated (additional comments in Nesom 1991). All three are relatively narrow endemics. The new species is distinguished from *L. hintoniorum* by its shorter corollas (13-15 mm long vs. 15-18 mm) and shorter, linear leaves 15-21 mm long and more or less evenly 2-3 mm wide, compared to those of the latter, which are obovate-oblanceolate, 20-35 mm long, and 5-11 mm wide in the distal portion at the broadest point. *Leucophyllum hintoniorum* is known from two collection sites in addition to its type locality, including one very near the type locality of *L. alejandrae*, and the two species appear to be genetically isolated.

Additional localities for *Leucophyllum hintoniorum*: Nuevo Léon: Mpio. Aramberri, near San Francisco, gypsum hillside, 1740 m, 13 May 1992, *Hinton et al. 21961* (TEX) and *21973* (TEX); Mpio. Zaragoza, Zaragoza to El Salitre, gypsum hillside, 1420 m, 17 Oct 1992, *Hinton et al. 22567* (TEX).

Besides *Leucophyllum alejandrae*, the only other linear leaved or relatively narrow leaved species in the genus are *L. pringlei* (Greenm.) Standl. and *L. revolutum* Rzed. (Henrickson & Flyr 1985). The former is a species of Oaxaca and Puebla with leaves glabrous except for sessile glands; the latter occurs in Tamaulipas and San Luis Potosí and produces eglandular, bicolorous, oblanceolate leaves with distinctly revolute margins.

ACKNOWLEDGMENTS

I thank Billie Turner and T.P. Ramamoorthy for their comments and review of the manuscript.

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Nesom, G.L. 1991. A new species of *Leucophyllum* (Scrophulariaceae) from Nuevo Léon, México. Phytologia 71:337-339.

Phytologia (April 1993) 74(4):296-304.

THREE SPECIES OF *ASTER* (ASTERACEAE: ASTEREAE) DISJUNCT IN NORTHERN COAHUILA, MEXICO

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ABSTRACT

Three species of *Aster* are disjunct and apparently rare in northern Coahuila, México, each at a southern extension from the main part of its geographic range. *Aster laevis* is widespread in the United States but the Coahuilan plants belong to the same population system that continues northwestward in the Guadalupe Mountains of Texas, the White Mountains of New Mexico, and continuing north in the Rocky Mountains. The range of *A. oolentangiensis* continues northward beginning in east Texas; that of *A. drummondii* continues to the northeast beginning in the Edwards Plateau of Texas. The geographic ranges of these are mapped for Texas and Coahuila, and similar distribution patterns are noted for species of other families.

KEY WORDS: *Aster*, Asteraceae, Astereae, Coahuila, Texas, biogeography

Among plants collected in northern Coahuila by David H. Riskind in 1977 and recently accessioned into LL,TEX are two species of *Aster* that represent the first known collections from México of both. The taxonomic status of these two and one other earlier collection by L. Wynd and C. Mueller from the same area is subject to various interpretations and is discussed below. Each of the three species is disjunct southward from the main part of its geographic distribution, and the long distance of separation, the nonweedy tendencies of the species involved, the natural habitats of the plants in México, and similar geographic patterns found in other species suggest that the disjunctions are relictual rather than recent cases of dispersal.

1. *Aster laevis* L., *Sp. Pl.* 876. 1753.

   Aster laevis L. var. *geyeri* A. Gray, *Synopt. Fl. N. Amer.* 1(2):183. 1884.

   Aster laevis L. var. *guadalupensis* A.G. Jones, Sida 9:173. 1981. TYPE: UNITED STATES. Texas: Culberson Co., Guadalupe Mountains, mouth of McKittrick Canyon, along stream, 2 Jul 1958, *D.S. Correll & I.M. Johnston 19156* (HOLOTYPE: LL!).

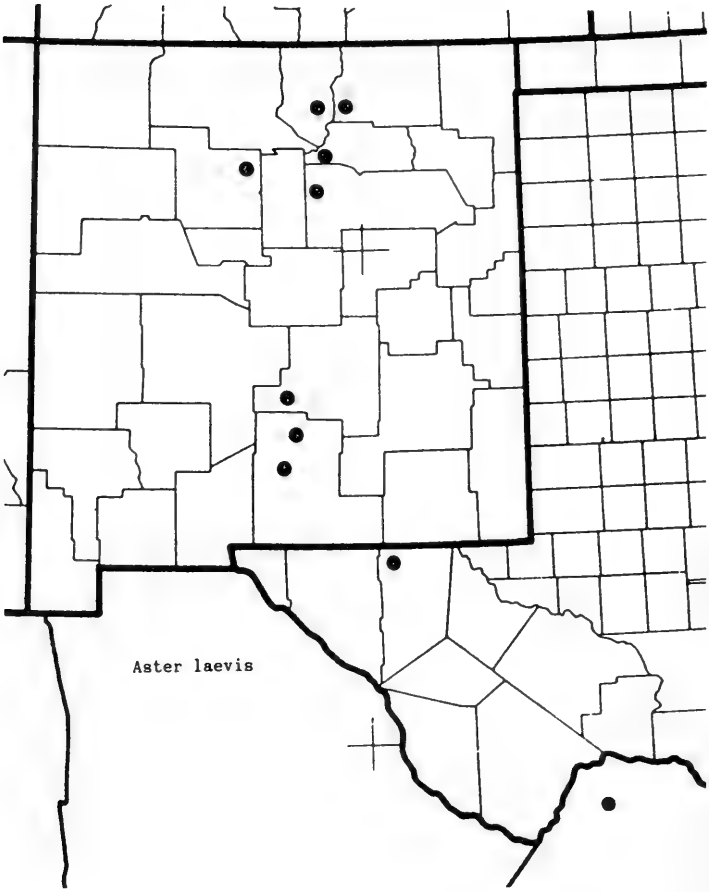
   Aster subsalignus Rydb., Bull. Torrey Bot. Club 37:140. 1910. TYPE: UNITED STATES. Colorado: Garfield County, Glenwood Springs, 18 Aug 1906, *G.E. Osterhout 3997* (HOLOTYPE: NY!; Isotype: RM).

   Aster laevis L. var. *strictiflorus* Osterhout, Muhlenbergia 6:47. 1910. TYPE: UNITED STATES. Colorado: Garfield County, Glenwood Springs, 18 Aug 1906, *G.E. Osterhout 3997* (HOLOTYPE: RM; Isotype: NY!).

Collections from MEXICO: Coahuila: Mpio. Villa Acuña, Serranias del Burro, Rancho El Bonito, ca. 29° 01′30″W, 102° 07′30″N: along logging road in Canyon El Bonito, ca. 11 km W of Rancho El Bonito headquarters, 1650 m, 17 Sep 1977, *Riskind 2101* (TEX); Canyon El Toro, intermittent drainage in limestone in a shaded slope with *Quercus muhlenbergii* and *Q. gravesii*, 18 Sep 1977, *Riskind 2145* (TEX) and *2157* (TEX); Canyon La Pantera, 19 Sep 1977, *Riskind 2232* (TEX).

Aster laevis is "an extremely variable species of wide distribution" (Jones 1980, p. 244) in the eastern United States and in the western U.S., where it occurs from the Dakotas to Oregon (and adjacent Canada) and southward along the Rocky Mountain cordillera into south central New Mexico and westernmost Texas. The specimens from Coahuila are identical to plants of *A. laevis* from the Guadalupe Mountains of Culberson Co., Texas, which were recently named as *A. laevis* var. *guadalupensis* (Jones 1981). There is a disjunction of more than 400 kilometers between the Coahuilan and Texan localities (Map 1), but the Guadalupe Mountains are essentially continuous with the White Mountains of Lincoln and Otero counties, New Mexico (also see Johnston 1979), where *A. laevis* apparently is more abundant and from where its range continues northward.

Jones (1981, pp. 172-173) characterized var. *guadalupensis* as having basal rosettes "strongly developed with several large, lanceolate, sessile or petiolate, glabrous and glaucous leaves still persistent when the plants are in flower (July through September). ...The cauline leaves in this variant are linear-lanceolate, abruptly reduced in size, the larger ones dilated at the clasping, sometimes auricled, base." In her key to three selected varieties of *A. laevis*, however, the only contrasts provided to distinguish var. *guadalupensis*



Map 1. Distribution of *Aster laevis* in Texas, México, and New Mexico; the range of the western North American segment of the species continues northward.

are "plants comparatively slender" (var. *guadalupensis*) vs. "plants typically stout" and "basal rosette leaves persistent at flowering time" (var. *guadalupensis*) vs. "basal rosette leaves withered at flowering time." I cannot find any consistently tangible features that correspond to "stout" and "comparatively slender," and the basal leaves of var. *guadalupensis* (in Culberson County) are conspicuously persistent only on the holotype. Persistent basal leaves can also be found on plants scattered through the entire range of the species.

Plants inseparable in morphology from *Aster laevis* in Texas and northern Coahuila are also abundant in Lincoln and Otero counties, New Mexico, and extend northward through New Mexico at least to the area of its border with Colorado (specimens in LL,TEX for San Miguel, Sandoval, Mora, and Colfax cos., New Mexico). These all have a tendency to produce cauline leaves that are relatively more widely spaced, stiffer, and more narrowly oblanceolate to narrowly elliptic lanceolate than those further north in the western United States as well as those in the eastern United States.

In northern New Mexico, southern Colorado, and the area somewhat northward, it may be possible to discern a trend toward slight widening of the leaves, but nearly linear leaved plants of *Aster laevis* continue to occur sporadically northward as far as Montana, Idaho, and Oregon. A collection of such from northwestern Colorado has been named as *A. laevis* var. *strictiflorus*, a name that can also be justifiably applied to the plants from Texas identified as var. *guadalupensis*. An even earlier name (*A. laevis* var. *simplex* Cockerell, West Amer. Sci. 6:10. 1889, the type from Colorado) may refer to the same plants. The western segment of *A. laevis* has generally been recognized as var. *geyeri*, and I am using this to refer to all of the western U.S. plants of the species until a more detailed study is available of variation within the whole species. Rydberg (1917) recognized four species now included as variants within *A. laevis*. Recent accounts of the flora of Colorado (Weber & Wittmann 1992) and New Mexico (Martin & Hutchins 1981), however, have recognized only var. *geyeri* from their respective areas. Var. *geyeri* has sometimes been observed (in floristic literature) to differ from var. *laevis* in producing smaller heads with less graduated involucral bracts, but even this may not be consistent.

It is significant to note that a trend toward production of narrow leaves also occurs in plants of *Aster laevis* in the eastern United States, where such have been formally recognized as *A. laevis* var. *concinnus* (Willd.) House (see Jones 1980). Cronquist (1980), however, maintained these as a separate species, *A. concinnus* Willd. Further, Cronquist included another eastern North American taxon, *A. purpuratus* Nees, as a synonym of *A. concinnus*, but Jones (1984) has maintained that the former represents yet another distinctive element within *A. laevis* (as var. *purpuratus* [Nees] A.G. Jones). The Coahuilan plants, however, are clearly connected with the cordilleran populations rather than those of eastern North America. In fact, except for the Culberson Co. population, *A. laevis* is not recorded from Texas. Numerous other varieties

and formas have been recognized within *A. laevis* on the basis of leaf shape, and it is clear that variation within the species needs to be studied before additional taxa are created or recognized.

Semple *et al.* (1989) reported the chromosome number of *Aster laevis* from the Guadalupe Mountains as n=24 and noted that the same number apparently invariably characterizes the species over its whole range (also see Jones 1980, Brouillet 1983, and Semple *et al.* 1992).

Examples of other species of northcentral México that, like *Aster laevis*, are distributed primarily northward through trans-Pecos Texas and into the Rocky Mountains and western North America are *Campanula rotundifolia* L., *Rhamnus betulaefolia* E. Greene, *Sisyrinchium demissum* E. Greene, and *Penstemon jamesii* Benth. *Potentilla propinqua* Rydb. appears to be long disjunct from the southern limit of its primary range in the New Mexico cordillera to near the northern end of the Sierra Madre Oriental east of Saltillo, Coahuila.

2. *Aster oolentangiensis* Riddell, West. J. Med. & Phys. Sci. 8:495. 1835.

Aster azureus Lindl. *in* Hook., Companion Bot. Mag. 1:98. 1835.

Aster vernalis Engelm. *ex* Burgess *in* Small, *Fl. Southeast. U.S.* 1215. 1903.

Aster poaceus Burgess in Small, *Fl. Southeast. U.S.* 1215. 1903. *Aster azureus* Lindl. var. *poaceus* (Burgess) Fern., Rhodora 51:95. 1949. *Aster oolentangiensis* Riddell var. *poaceus* (Burgess) A. Jones, Bull. Torrey Bot. Club 110:41. 1983.

Collections from MEXICO: Coahuila: Mpio. Villa Acuña, Serranias del Burro, Rancho El Bonito, ca. 29° 01′30″W, 102° 07′30″N: Canyon El Toro, intermittent drainage in limestone in a shaded slope with *Quercus muhlenbergii* and *Q. gravesii*, 18 Sep 1977, *Riskind 2125* (TEX) and *2135* (TEX); head of Canyon El Bonito on plateau of open pine-oak woodland, 2300 m, 20 Sep 1977, *Riskind 2266* (TEX).

Aster oolentangiensis is widely distributed in the central and eastern United States and into southern Ontario, Canada. The southern limit of its primary range is in Harris County of southeastern Texas (Map 2), where it is disjunct from the Mexican populations by a distance of more than 650 kilometers. The Coahuilan plants represent the form with narrow cauline leaves that has been recognized as var. *poaceus* (Jones 1983) and *A. vernalis* (Correll & Johnston 1970), found primarily from Texas through Arkansas and into Missouri. There appears to be significant intergradation between the typical and the narrow leaved forms, however, and Cronquist (1980) recognized *A. poaceus* only as a synonym of *A. azureus*, without distinctive biological or taxonomic status. The lower leaves of the Coahuilan plants show the same array of shapes as

observed by Shinners (1941, p. 408) in the same species in Wisconsin: the blades "vary from deeply cordate at base to merely truncate, or sometimes all but the lowest are tapered to the petiole."

The disjunction between east Texas and northern Coahuila in *Aster oolentangiensis* probably represents a specialized case of the more common pattern found in *A. drummondii* (below), where northern Coahuilan plants also occur on the Edwards Plateau of Texas, from where they may or may not extend further north and east. The particularly wide separation of the southern populations of *A. oolentangiensis* is unusual, however, and I have not encountered similar examples.

3. *Aster drummondii* Lindl. *in* Hook., Companion Bot. Mag. 1:97. 1835.

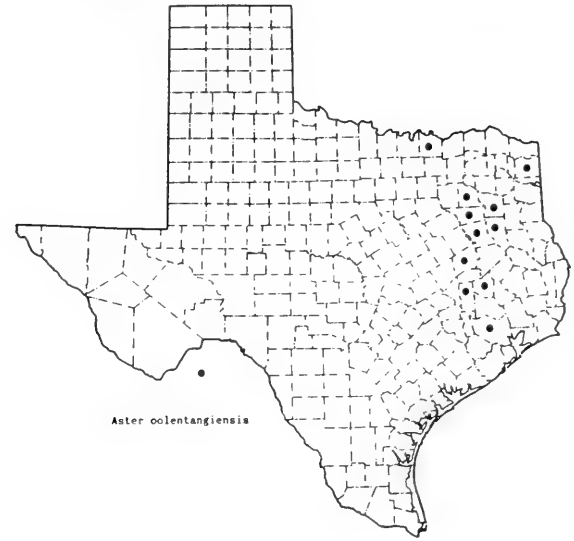
Aster texanus Burgess *in* Small, *Fl. Southeast. U.S.* 1214. 1903. *Aster drummondii* Lindl. subsp. *texanus* (Burgess) A.G. Jones, Phytologia 55:380. 1984. *Aster drummondii* Lindl. var. *texanus* (Burgess) A.G. Jones, Phytologia 63:131. 1987.

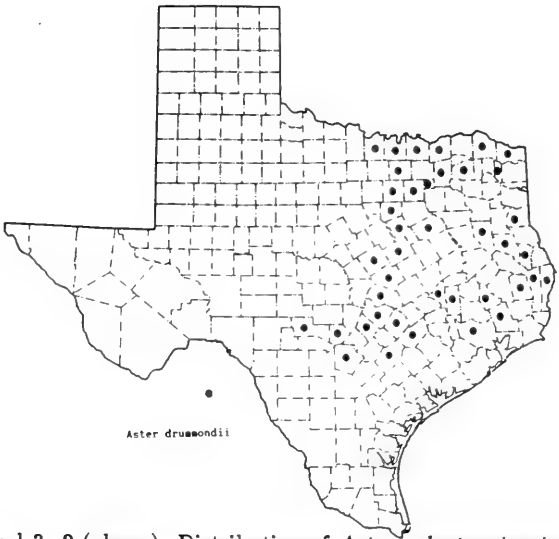
Aster coahuilensis S.F. Blake, J. Washington Acad. Sci. 27:377. 1937. TYPE: MEXICO. Coahuila: Mpio. Muzquiz, moist wooded canyon on the E slope of the Sierra de San Manuel, 30 Jun 1936, *F.L. Wynd & C.H. Mueller 372* (HOLOTYPE: US!).

Aster drummondii is common on the Edwards Plateau of Texas, with an intervening distance of more than 300 kilometers between those populations and the single known locality in México (Map 3). Both the Texan and Mexican plants represent the segment of the species known as var. *texanus*, which occurs from Texas and Louisiana to Kansas and western Kentucky. Var. *texanus* is distinguished by its finely strigillose achenes (vs. glabrous in var. *drummondii*). In slightly different and intergrading forms, the species continues northward to Minnesota (see Jones 1984). Most collections of *A. drummondii* are tetraploid, with diploids relatively rarely known from populations of var. *drummondii* (Jones 1980).

The Mexican plant collected by Wynd & Mueller (*Aster coahuilensis*) was noted by Blake in the original description as resembling *Aster laevis* in its inflorescence, and a recent annotation (1990) by Almut Jones has noted that the plant is perhaps influenced by genes of *A. laevis*. There are plants of *A. drummondii*, however, on the Edwards Plateau of Texas that are a close match for the Mexican collection, and I find no compelling evidence to call a hypothesis of hybridization to account for the variation. As noted above, *A. laevis* does not even occur in Texas, except for the rare plants in the Guadalupe Mountains, where *A. drummondii* is not found.

The floristic relationship between northern Coahuila and the Edwards Plateau is strongly established by evidence from numerous other species of





Maps 2 and 3. 2 (above). Distribution of *Aster oolentangiensis* in Texas and México; the range continues northward and eastward. 3 (below). Distribution of *Aster drummondii* in Texas and México; the range continues northward and eastward.

various families that show a similar pattern of distribution, as demonstrated by the examples below. The Edwards Plateau is primarily a limestone based region, dissected by a number of drainages and characterized mostly by open, juniper-scrub oak woodlands. Relatively similar areas in northern Coahuila are separated by the Rio Grande plains. In the following, the plants occur most abundantly in Texas, the Coahuilan populations rare or relatively so: *Grindelia lanceolata* Nutt. var. *texana* (Scheele) Steyerm., *Grindelia grandiflora* Hook., *Prunus mexicana* S. Wats., *Sisyrinchium dimorphum* Oliver, *Solidago petiolaris* Ait., *Taxodium distichum* (L.) Rich., *Stenostiphon filifolium* (Nutt.) Heynh., *Triodanis coloradoensis* (Buckl.) McVaugh, *Physostegia correllii* (Lundell) Shinners, *Physostegia praemorsa* Shinners, and *Lythrum ovalifolium* Engelm. *ex* Koehne. *Viburnum rufidulum* Rafin. is common in the eastern United States, rare on the Edward's Plateau, then disjunct to northern Coahuila as well as one area in trans-Pecos Texas. Several species show the same pattern of distribution but apparently have their primary range in Mexico, from there disjunct northward to the Edwards Plateau: *Chamaesaracha edwardsiana* Averett is most abundant in Coahuila and west central Nuevo León, uncommon on the Edwards Plateau; and *Erigeron mimegletes* Shinners also is relatively common in some areas of north central México but rare on the Edwards Plateau.

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THE GENUS *OREOSTEMMA* (ASTERACEAE: ASTEREAE)

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ABSTRACT

A group of taxa of western North America that have most recently been treated as a subgenus within *Aster* is here regarded as the separate genus *Oreostemma*: **O. peirsonii** (Sharsmith) Nesom, *comb. nov.*, *O. elatum* (E. Greene) E. Greene, and *O. alpigenum* (Torr. & Gray) E. Greene (the generitype). Three varieties are recognized within *O. alpigenum*: var. *alpigenum*, var. **andersonii** (A. Gray) Nesom, *comb. nov.*, and var. **haydenii** (Porter) Nesom, *comb. nov.* *Oreostemma* is anomalous within *Aster*, but a close morphological similarity, however, is noted between *Oreostemma* and the primarily South American genus *Oritrophium*.

KEY WORDS: *Oreostemma*, *Aster*, Asteraceae, Astereae

Recent taxonomic overviews of the genus *Aster* L. have recognized a group of three species from the western United States as *Aster* subg. *Oreostemma* (E. Greene) Peck (Jones 1980) or *Aster* "subg. *Oreastrum*" (Semple & Brouillet 1980). In a revisionary treatment of the group, Cronquist (1948) also treated these species within *Aster*, while confirming their status as a natural group. The first described species among them (see citations below), however, was placed in *Haplopappus* DC. (as *H. alpigenus*) by Torrey & Gray, who judged that its closest relatives were among those of *Haplopappus* sect. *Pyrrocoma* (Hook.) H.M. Hall. In the description of the second species (*Erigeron andersonii*), Gray offered the following comment (1865, p. 540): "This is a North American representative of the Andine group of species, sometimes referred to *Aster*, which Schultz has recognized as identical with *Celmisia* [Cass.], and Weddell has referred to *Erigeron* [L.]." These primarily South American species are now identified as the genus *Oritrophium* (Kunth) Cuatr. (Nesom 1992a). Gray soon became dissatisfied with the disparity of this latter species with North American *Erigeron* and transferred it to the highly heterogeneous

Aster sect. *Orthomeris* Torr. & Gray, there placing it closest to species now treated as the genus *Xylorhiza* Nutt. A short time later, with more collections at hand, he also transferred *H. alpigenus* to *Aster*, noting that its rays were violet, not yellow, and offering the following observation (1872, p. 389): "The species is nearly allied to *A. andersonii*, Gray; and with *A. pulchellus* of Eaton (just published in the Botany of King's Exploration), we have now three subscapigerous species of this group." Formal taxonomic recognition of this small group of species was first provided by E.L. Greene (1896, 1900), who treated it at generic rank as *Oreostemma* E. Greene (see nomenclature below).

Greene (1896) noted that the plants of *Oreostemma* are "related to *Aster* somewhat less intimately than are their Atlantic American analogues, the species of *Heleastrum* [DC.]," apparently emphasizing their similar production of long, parallel veined leaves that tend to be basally disposed. Plants of *Heleastrum*, however, are very different from *Oreostemma* in their cormoid rhizomes, leafy stems with densely spaced peduncular bracts subtending the involucres, capitulescences primarily corymboid but sometimes reduced to a spicate arrangement, even more rarely further reduced to a single head, phyllaries with a well defined, basally truncate apical patch, and pappus bristles with dilated apices. It seems improbable that the two taxa are closely related.

Cronquist (1948) stated that the *Oreastrum* group is "clearly related" to *Aster occidentalis* (Nutt.) Torrey but provided no details of justification. The latter species has most recently been hypothesized to be closely related to *A. ascendens* Lindl., *A. chilensis* Nees, and others, treated by Jones (1980) within subg. *Symphyotrichum* (Nees) A.G. Jones. Nor has the *Oreastrum* group been considered in detailed studies of the *A. occidentalis* complex (*e.g.*, Dean & Chambers 1983; Allen 1984). In the phylogenetic analysis of *Aster* sensu lato by Jones & Young (1983), *Aster* subg. *Oreostemma* (as they treated it) was phylogenetically coordinate with their "*Galatella* s.l.;" *Oreostemma* and "*Galatella*" in turn together formed the sister group to the entire remainder of *Aster*. The taxa composing "*Galatella*" sensu Jones & Young are now hypothesized to be more closely related to the goldenaster lineage (the genus *Ionactis*, Nesom & Leary 1992; Nesom 1992b; Nesom 1991b) and the Solidagininae (sensu Nesom 1991b, in press, in prep.). Plants of *Oreostemma* do not produce strongly keeled phyllaries, disc corollas with long, recurved coiling lobes, a double pappus, or *Solidago*-type collecting appendages of the disc style branches, features that would link them to taxa placed in the goldenaster or *Solidago* lineages. After the dispersal of the taxa of "*Galatella* s.l." sensu Jones & Young to genera outside of *Aster* (Nesom in prep.), *Oreostemma* remains one of the disparate, apparently basal elements of the *Aster* alliance, without features that would clearly ally it with other of the Old World or New World groups remaining in *Aster* sensu lato. Jones & Young (1983, p. 78) noted that *Oreostemma* is "The one group emerging on this cladogram [their Fig. 2] as a seemingly well-founded segregate from *Aster* ...;" in their summary diagram

of the phylogeny of *Aster* (their Fig. 5), they placed *Oreostemma* as one of the seven major groups of the genus, each of the latter independently derived from a "hypothetical common ancestor."

Recent consideration of the genus *Oritrophium* (Nesom 1992a) has brought into focus its similarity to *Oreostemma*, substantiating Asa Gray's original observation. Plants of *Oritrophium* are distinctive in their base chromosome number of $x=9$ and their perennial, herbaceous habit, basal rosettes of narrow, primarily 1 or 3 nerved leaves arising from a short, thick rhizome, vestiture of long, thin hairs (Type B trichomes, see below) commonly produced by the lower petioles, monocephalous stems, noncarinate phyllaries without a distinctly developed apical patch, ray flowers with white ligules, disc flowers with linear style branches, achenes somewhat terete and mostly 5 veined, and a pappus of numerous, slender, barbellate bristles but without a differentiated outer series. *Oritrophium* has been considered a subgroup of *Aster*, and if such plants occurred in the United States, they presumably would still be absorbed within *Aster* (sensu lato) as the sister group of *Oreostemma*. Plants of *Oreostemma* do not produce the long, silky trichomes often found in *Oritrophium* but the primary difference between the two taxa is the production of functionally staminate disc flowers in *Oritrophium*, the disc style branches with a corresponding lack of stigmatic lines.

Oreostemma is a well defined, easily recognized, and accepted natural group, but if it remains within *Aster*, its phylogenetic position is highly ambiguous. In contrast, at least a potential, reasonable sister group to *Oreostemma* has been identified in *Oritrophium*. Further, the recognition of *Oreostemma* as a genus separate from *Aster* is a significant step toward allowing the morphological definition of the latter to become more internally consistent. The three species of *Oreostemma* are distinguished by the features in the technical description below, but the identification of the group is much simpler, as there are no other species within North American *Aster* sensu lato that produce erect caudices bearing monocephalous, scapiform stems. Most of the plants of *Oreostemma* are taprooted, but as observed by Cronquist (1948), forms of *A. alpigenus* show transitions from a taprooted habit to a fibrous rooted one. Plants of all taxa of the genus, however, produce the short, erect caudices. Otherwise within *Aster* sensu lato, taproots are found only in *A. tripolium* L., the annual species of subg. *Oxytripolium* (DC.) Torrey & Gray (sensu Sundberg 1986), and the species of *Brachyactis* Ledeb. All of the latter are fundamentally different from *Oreostemma* in a number of ways. Even if *Oreostemma* were considered to have fibrous roots and a multiheaded capitulescence, it would still remain an anomalous element within *Aster*, as none of the categories identified by Jones (1980) or by Semple & Brouillet (1980) could accommodate these three species.

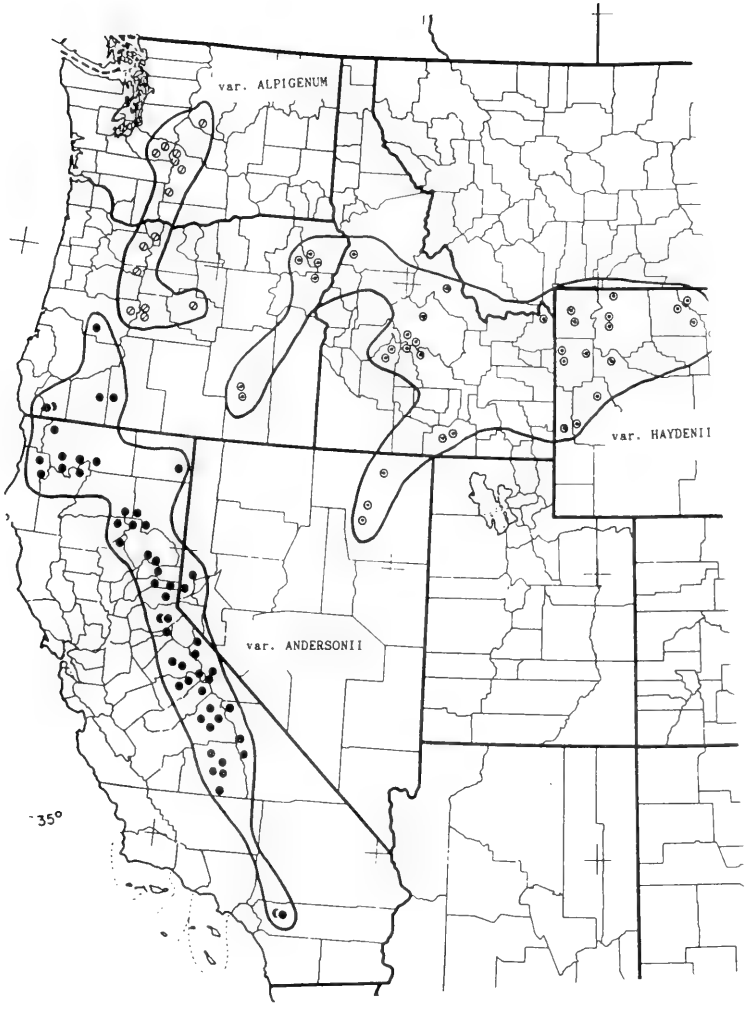
In American *Aster*, outside of the species of *Oreostemma*, monocephalous stems occur only in *A. alpinus* L. var. *vierhapperi* (Onno) Cronq. (subg. *Aster*,

sensu Jones 1980 and Nesom in prep.). In contrast to the superficial habital resemblance, *A. alpinus* differs from *Oreostemma* in the production of relatively slender, fibrous rooted (never taprooted), horizontal rhizomes without a definite caudex, subclasping cauline leaves gradually reduced in size upward, and obovate, strongly flattened, and primarily 2 nerved achenes. *Aster* sensu stricto and *Oreostemma* clearly are not closely related.

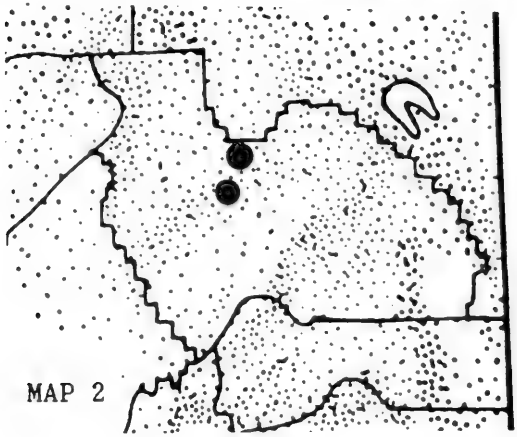
Following Greene's concept, *Aster* subg. *Oreostemma* (the "Oreastrum group") is treated here at the rank of genus. Details of typification are provided in earlier studies (Cronquist 1948; also see Jones & Lowry 1986).

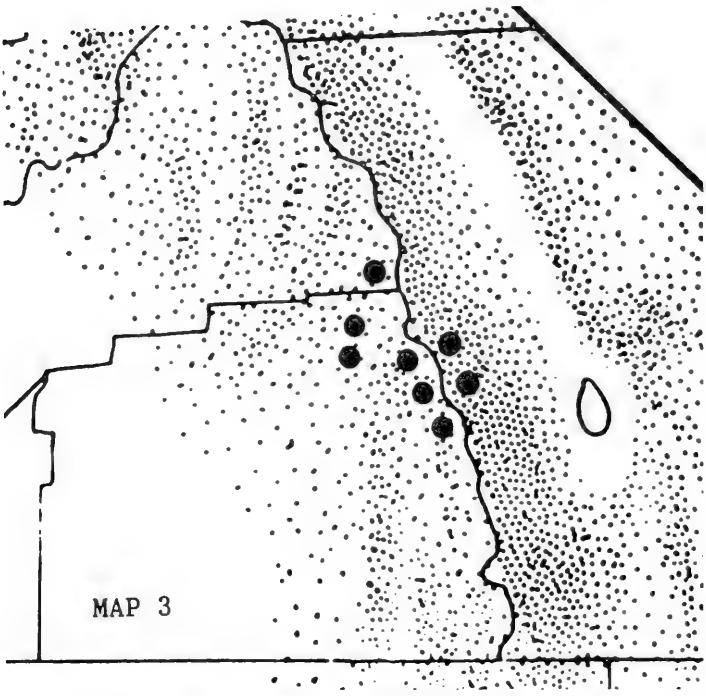
Oreostemma E. Greene [*nom. nov.*], Pittonia 4:224. 1900. Based on *Oreastrum* E. Greene, Pittonia 3:146. 1896. Not *Oriastrum* Poeppig, 1843. *Aster* subg. *Oreostemma* (E. Greene) Peck, *Man. Higher Pl. Oregon* 719. 1941. TYPE: *Oreostemma alpigenum* (Torr. & Gray) E. Greene

Perennials with erect caudices, arising from a stout taproot, often developing erect or ascending caudex branches, less commonly from a short, fibrous rooted rhizome, rarely this developed into a distinctly elongated rhizome. Stems scapiform, monocephalous. Leaves subcoriaceous, entire, the basal in a persistent rosette, narrow, primarily 1 nerved but commonly with a pair of well developed, parallel, secondary nerves, the cauline greatly reduced in size, sessile, slightly subclasping to not at all clasping. Vestiture of stems and leaves (see Nesom 1976): Type B trichomes (uniseriate, thin walled) greatly lengthened, loosely villous, Type A trichomes (uniseriate, thick walled) absent, Type C trichomes (biseriate, usually glandular) abundant in *Oreostemma peirsonii*, absent in the other two species. Phyllaries slightly or not at all keeled, distally herbaceous but sometimes indurated near the base, without a demarcated apical patch, the apices also foliaceous adaxially. Ray corollas white, sometimes purplish, the ligules coiling. Disc corollas with deltate, erect lobes; style branches 2.5-2.8 mm long, the collecting appendages linear narrowly lanceolate, evenly hispid from base to tip, stigmatic lines ca. 1/2-1/5 as long as the appendages (in *O. alpigenum* and *O. elatum*, appendages 2.0-2.2 mm long, stigmatic lines 0.4-0.5 mm long; in *O. peirsonii*, appendages 1.5-1.8 mm long, stigmatic lines 0.7-0.9 mm long). Achenes 4-5 mm long, narrowly oblong, subterete to slightly compressed, with 5-10 thin, superficial nerves; carpopodium mostly symmetric; pappus a single series of ca. 25-40, slender, terete to slightly flattened bristles. The pappus of these taxa was described as double (Jones & Young 1983), but as observed by Cronquist (1948), the upwardly protruding, duplex achenial hairs may give the appearance of an outer series. Chromosome numbers of n=9 and n=18 have been reported for *O. alpigenum* (Huziwara 1958; Raven *et al.* 1960; Semple *et al.* 1983, 1989, 1992), all counts apparently for var. *andersonii*. Karyotype, "primitive type" sensu Semple *et al.* (1983). Maps 1-3.



Map 1. Geographic distribution of the varieties of *Oreostemma alpigenum*.





Map 2. Geographic distribution of *Oreostemma elatum*; all known records from north central Plumas Co., California.

Map 3. Geographic distribution of *Oreostemma peirsonii*; all records from Fresno, Tulare, and Inyo cos., California.

I agree with Cronquist's treatment (1948) of *Oreostemma* (as "the *Oreastrum* group") with respect to the delimitation of the taxa. As treated here, the genus comprises three species, two of them highly restricted in geographic range, the third widespread and variable but divisible into three geographically distinct varieties. As noted by Cronquist (p. 78), "Individual specimens from well within the range of one [variety of *O. alpigenum*] might pass for the other in the absence of geographic data," and populations lying between or at the peripheries of the major portions of the range of each variety also tend to be morphologically intermediate. "In spite of the obvious intergradation, however, a very large proportion of the specimens from the whole range of the [three varieties] can be identified without question from their gross morphology, and the existence of regionally differentiated units can scarcely be denied" (p. 80).

Plants of both var. *alpigenum* and var. *haydenii* are relatively uniform in morphology. Plants intermediate between them in leaf shape occur along the western edge of the range of var. *haydenii* (*e.g.*, the Blue and Wallowa Mountains of Oregon; Cassia and Custer cos. of Idaho). Although some plants in these areas produce distinctly rounded leaf apices similar to var. *alpigenum*, they are mixed with typical var. *haydenii* and have relatively thick leaves more similar to the latter. Similarly, plants from around Breitenbush Lake in Marion Co., Oregon, cited by Cronquist (1948, p. 79) as examples of "true intergradation" between var. *alpigenum* and var. *andersonii*, are variable in achenial vestiture but well within the geographic range of var. *alpigenum* and similar to it in leaf morphology. In turn, small plants of var. *andersonii* might be indistinguishable in leaf morphology from var. *haydenii*. Var. *andersonii*, however, is a great deal more variable in morphology and ecology than either of the other varieties (see key and further comments below). Application of varietal names to plants of *Oreostemma alpigenum* as shown in Map 1 provides the most consistent means of identification.

The following key affirms previous observations regarding distinctions among the taxa of *Oreostemma* and adds some refinement. It is provided here with distribution maps (Maps 1-3) as a companion to the summary and discussion of the taxonomy.

1. Phyllaries, stems, and often the leaves densely invested with short stipitate glands; stems 2-7 cm high. ..... *O. peirsonii*

1. Herbage eglandular, otherwise glabrous or sparsely to moderately villous with thin hairs; stems 4-70 cm high. ..... (2)

   2. Stems, leaves, and phyllaries completely glabrous; phyllaries strongly indurated-stramineous in the basal portion, the outer 1.5-2.0 mm

wide near the base, 3 nerved, the nerves separating the phyllary into 4 longitudinal, indurated bands. ..... *O. elatum*

2. Stems, leaves, and phyllaries densely pubescent to glabrate, but at least some hairs always perceptible on the lower part of the phyllaries and the stem near the head; phyllaries herbaceous from base to tip or slightly tawny indurated in the basal portion, the outer 0.8-1.2 mm wide near the base, 1 nerved. ..... *O. alpigenum* (3)

3. Basal leaves oblanceolate with obtuse to rounded apices, (3-)6-10(-15) cm long, 6-12 mm wide; stems 5-18(-30) cm high. ..... *O. alpigenum* var. *alpigenum*

3. Basal leaves linear-oblanceolate to narrowly oblanceolate with acute apices, 3-12(-35) cm long, mostly less than 6 mm wide; stems mostly 4-15 or 8-40 cm high. ..... (4)

4. Basal leaves (3-)4-9(-12) cm long, (1-)2-4(-6) mm wide; stems mostly 4-15 cm high; achenes mostly hairy only at the apex. ..... *O. alpigenum* var. *haydenii*

4. Basal leaves (3-)8-12(-35) cm long, (1-)2-6(-9) mm wide; stems (4-)8-40(-70) cm high; achenes mostly hairy from base to apex. ..... *O. alpigenum* var. *andersonii*

1. *Oreostemma alpigenum* (Torr. & Gray) E. Greene, Pittonia 4:224. 1900. BASIONYM: *Haplopappus alpigenus* Torr. & Gray, *Fl. N. Amer.* 2:241. 1842. *Aster alpigenus* (Torr. & Gray) A. Gray, Proc. Amer. Acad. Arts 8:389. 1872. *Oreastrum alpigenum* (Torr. & Gray) E. Greene, Pittonia 3:147. 1896.

a. *Oreostemma alpigenum* (Torr. & Gray) E. Greene var. *alpigenum*

Map 1; alpine meadows, commonly in markedly wet or moist areas, lake edges, clearings in subalpine pine-fir woods, less commonly along ridges; 5000-7000(-7500) ft; July-September.

b. **Oreostemma alpigenum** (Torr. & Gray) E. Greene var. **andersonii** (A. Gray) Nesom, *comb. nov.* BASIONYM: *Erigeron andersonii* A. Gray, Proc. Amer. Acad. Arts 6:540. 1865. *Aster andersonii* (A. Gray) A. Gray, Proc. Amer. Acad. Arts 7:352. 1868. *Oreastrum andersonii* (A. Gray) E. Greene, Pittonia 3:147. 1896. *Oreostemma andersonii* (A. Gray) E. Greene, Pittonia 4:147. 1900.

Aster alpigenus (Torr. & Gray) A. Gray subsp. *andersonii* (A. Gray) Onno, Bibl. Bot. 26 (Heft 106):15. 1932. *Aster alpigenus* (Torr. & Gray) A. Gray var. *andersonii* (A. Gray) Peck, *Man. Higher Pl. Oregon* 721. 1941.

Map 1; bogs (sometimes with *Darlingtonia*), marshes, moist to wet meadows, lake edges, pine woods to alpine tundra; (4000-)5000-11,000(-11,500) ft; June-September.

Particularly large plants of var. *andersonii* occur in southwestern Oregon, Nevada, and adjacent California (Sierra and Nevada cos.), where the stems may be up to 65-70 cm tall and the basal leaves up to 35 cm long. Tetraploids have been reported from var. *andersonii* (see above), and it is possible that the conspicuous size increase may be correlated with an increase in ploidy level. Achenes are usually hairy from base to apex, but variants occur throughout the range of the variety, and one collector reported that within a single population, achenes were hairy "throughout to only above" (California, Fresno Co., *Sharsmith 8174*-NY). Cronquist (1948) noted analogous examples of variation within populations of var. *alpigenum*. Plants with filiform leaves are particularly common from Mono Co. south to Tulare Co.; forms with much broader leaves, however, as well as a complete range of intermediates, occur throughout the same area. The variation appears to be between populations rather than within them, but there is no discernible geographic pattern to the variation in leaf morphology, and it seems clear that only a single evolutionary entity is represented.

c. **Oreostemma alpigenum** (Torr. & Gray) E. Greene var. **haydenii** (T.C. Porter) Nesom, *comb. nov.* BASIONYM: *Aster haydenii* T.C. Porter, *Cat. Pl.* 485 *in* Hayden, *Prel. Rep. U.S. Geol. Surv. Montana.* 1872. *Oreastrum haydenii* (T.C. Porter) Rydb., Mem. New York Bot. Gard. 1:398. 1900. *Oreostemma haydenii* (T.C. Porter) E. Greene, Pittonia 4:224. 1900. *Aster alpigenus* (Torr. & Gray) A. Gray subsp. *haydenii* (T.C. Porter) Cronq., Leafl. West. Bot. 5:77. 1948. *Aster alpigenus* (Torr. & Gray) A. Gray var. *haydenii* (T.C. Porter) Cronq., *Vasc. Pl. Pacific Northw.* 5:76. 1955.

Aster pulchellus D.C. Eat., *Bot. King Exped.* 143. 1871; not *Aster pulchellus* Willd. (1803).

Map 1; rocky slopes, talus, ridges, most commonly in alpine tundra but also occurring lower in clearings in pine-fir or pine-spruce woods, sometimes around lake edges or near snow banks but more commonly in drier sites; 8700-11,000 ft; (June-)July-September.

2. *Oreostemma elatum* (E. Greene) E. Greene, Pittonia 4:224. 1900. BASIONYM: *Oreastrum elatum* E. Greene, Pittonia 3:147. 1896. *Aster elatus* (E. Greene) Cronq., Leafl. West. Bot. 5:80. 1948.

Narrowly endemic to northcentral Plumas Co., California (Butterfly Valley and Mt. Dyer), and perhaps immediately adjacent Lassen Co., Map 2; bogs, marshy areas, wet meadows; ca. 3300-5000 ft; July-August.

Cronquist recognized this taxon as a separate species, albeit hesitantly, but I agree with his observations and confirm its distinction from *Oreostemma alpigenum*. *Oreostemma elatum* is represented by few collections, but they are from several localities, made over a period of nearly 100 years (the first in 1875), and the morphology of the plants is highly consistent.

3. **Oreostemma peirsonii** (C.W. Sharsmith) Nesom, *comb. nov.* BASIONYM: *Aster peirsonii* C.W. Sharsmith, Leafl. West. Bot. 5:50. 1947.

Narrowly endemic to the high sierra near the junction of Fresno, Tulare, and Inyo cos., Map 3; rocky slopes, ridges, dry meadows; 10,300-12,250 ft; July-September.

Although *Oreostemma peirsonii* is a narrow endemic, it is represented by numerous collections. It is sympatric with *O. alpigenus* var. *andersonii*, and plants of the two taxa sometimes grow in close proximity. Raven collected both at Wright Lakes, 11,200 ft, in Tulare County and noted a marked difference in habitat: *O. peirsonii*, dry sand (*Raven 8360*-CAS), var. *andersonii*, wet meadow (*Raven 8361*-CAS). No hybrids between the two have been reported, and although scattered individuals of var. *andersonii* may produce a few glands on the phyllaries, there is no clear indication that such plants might be of hybrid origin.

ACKNOWLEDGMENTS

I thank Billie Turner and Luc Brouillet for their review and comments on the manuscript and the staffs of CAS and NY for loans of specimens. Records for the distribution maps are from specimens examined from CAS, LL,TEX, and NY, with a few additional ones from citations in Cronquist (1948).

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A NEW SPECIES OF *PERYMENIUM* (ASTERACEAE, HELIANTHEAE) FROM JALISCO,MEXICO

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ABSTRACT

A new species of *Perymenium*, **P. cualense** B.L. Turner is described from México. It is closely related to *P. uxoris* McVaugh but differs in having thicker, more venose, hispid-pilose leaves and larger heads with more numerous florets.

KEY WORDS: Asteraceae, Heliantheae, *Perymenium*, México

Routine identification of Mexican Asteraceae has revealed the following novelty.

Perymenium cualense B. Turner, *sp. nov.* TYPE: MEXICO. Jalisco: "Km 9 of the road to Minas de Cuale (unpaved road approximately 9 km W of El Tuito just off the road to Puerto Vallarta)." Occasional plants in oak-pine forest, 1050 m, 7 Mar 1992, *José L. Panero, Alvaro Campos, & Lidia Cabrera 2860* (HOLOTYPE: MEXU!; Isotype: TEX!).

Perymenio uxori McVaugh similis sed differt caulibus dense hispidi-tomentosis (vs. strigosis trichomatibus minutis), foliis crassioribus reticulatioribusque, et capitulis campanulatis majoribusque flosculis radii ac disci numerosioribus (radii 8 vs. 5, discii 10-17 vs. 4-6).

Shrubs 1.0-1.5 m high. Stems densely tomentose to hispid-pilose. Leaves mostly 8-12 cm long, 1.6-3.0 cm wide; petioles 5-12 mm long, pubescent like the stems; blades lanceolate, pinnately nervate, hispid-pilose, more so below, the margins serrulate. Heads 10-30 in terminal, leafy, congested cymes, the ultimate peduncles mostly 1-5 mm long. Involucres campanulate, the bracts 3-4 seriate, subgraduate, 4-7 mm long, the inner series broad and scarious with

rounded ciliate apices. Receptacle plane, the pales lanceolate-linear, 5-6 mm long. Ray florets 8, pistillate, fertile, the ligules yellow, 6-7 mm long, 2-3 mm wide. Disk florets mostly 10-17, the corollas yellow, ca. 6 mm long, the tube ca. 2 mm long, the lobes ca. 0.6 mm long, hispidulous. Achenes, 3.0-3.5 mm long, those of the ray 3 sided with narrow wings, those of the disk flattened, wingless, the pappus of numerous deciduous bristles mostly 2.0-2.5 mm long.

ADDITIONAL SPECIMENS EXAMINED: MEXICO. Jalisco: Steep mountainsides 3-10 km generally E on the road to Mina del Cuale, from the junction 5 km NW of El Tuito, Mpio. Cabo Corrientes, 16-19 Feb 1975, pine-oak forest on decomposed granitic soils, 850-1150 m, *McVaugh 26361* (MICH,TEX); 2.5 mi NW of El Tuito, 850 m, 12 Jan 1993, *Mayfield 1642* (MEXU,TEX).

Perymenium cualense is closely related to *P. uxoris* McVaugh of Nayarit. Indeed, McVaugh (1984) included a collection (*McVaugh 26361*, MICH) of the present taxon in his concept of *P. uxoris*, noting that "In the plants from Jalisco the leaves are rougher than those of the type-collection, the pubescence of the whole plant is more abundant, and the disk-flowers are up to 15-17 in each head." In detail, the leaves are more reticulate, with thicker, more numerous, more elevated, lateral veins (6-7 lateral veins to a side, vs. 3-5), ray florets are 8 (vs. 5) and the stems are densely hispid-pilose with spreading hairs (vs. sparsely to moderately short-strigose, the hairs appressed).

Perymenium cualense occurs in the Sierra de Cuale of Jalisco in oak-pine forests at about 1000 m; *P. uxoris* reportedly occurs in an oak-savannah region of southern Nayarit in sandy soils at about 200 m. McVaugh (1984) presented an excellent illustration of the latter.

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BROMUS, SECTION *PNIGMA*, IN NEW MEXICO, WITH A KEY TO THE BROMEGRASSES OF THE STATE[1]

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ABSTRACT

The distribution, nomenclature, and taxonomy of New Mexico species of *Bromus* section *Pnigma* were reviewed. Discriminant analysis of nine morphologic features suggested the recognition of five species in New Mexico: *B. anomalus*, *B. ciliatus*, *B. frondosus*, *B. lanatipes*, and *B. porteri*. *Bromus richardsonii* and *B. mucroglumis* were subsumed within *B. ciliatus* and *B. lanatipes*, respectively. Pubescence patterns, glume nervature, lemma lengths, and anther lengths were the most valuable distinguishing features. A key to all New Mexico *Bromus*, descriptions, specimen citations, and illustrations are presented.

KEY WORDS: Gramineae, *Bromus*, New Mexico

Approximately sixteen species of bromegrass (genus *Bromus*) occur in New Mexico. Half of these are weedy, adventive, annual species found mostly throughout the state along roadsides, in abandoned fields, and on disturbed ground. The remaining eight species are perennials occurring in numerous cool season floras in the state: riparian and canyon communities, piñon/juniper woodlands, pine forests, oak woodlands, high elevation mixed conifer forests, and mountain meadows and parklands. Several of these perennial species provide important grazing forage for wildlife and domestic livestock.

Traditionally (Hitchcock & Chase 1951), the perennial bromes of North America have been aligned with two sections of the genus *Bromus*: *Ceratochloa* and *Bromopsis*. The species of concern here fall within the old section *Bromopsis*. Smith (1970), reviewing the nomenclature of the genus, confirmed the invalid use of the name *Bromopsis* at the sectional rank, and justified its replacement by *Pnigma*. Some workers (Holub 1973; Weber 1987, 1990) have

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Table 1. Taxonomic disposition by various authors of New Mexico species of *Bromus* section *Pnigma*.

	anomalus	*ciliatus*	*frondosus*	*lanatipes*	*porteri*	*richardsonii*	*mucroglumis*
Wooton & Standley 1915	n/a	n/a	*frondosus*	*lanatipes*	*porteri*	*richardsonii*	n/a
Hitchcock & Chase 1951	*anomalus*	*ciliatus*	*frondosus*	var. of *anomalus*	*anomalus*	*ciliatus*	n/a
Wagnon 1952	*anomalus*	*ciliatus*	*frondosus*	*lanatipes*	*porteri*	*richardsonii*	*mucroglumis*
Soderstrom & Beaman 1968	*anomalus*	*ciliatus*	*porteri*	*lanatipes*	*porteri*	*ciliatus*?	*anomalus*?
Cronquist *et al.* 1977	*anomalus*	*ciliatus*	n/a	n/a	*anomalus*	*ciliatus*	n/a
Martin & Hutchins 1980	*anomalus*	*ciliatus*	*frondosus*	*lanatipes*	*anomalus*	*richardsonii*	n/a
Arnow 1987	*anomalus*	*ciliatus*	*anomalus*	n/a	*anomalus*	*ciliatus*	n/a
Weber & Wittmann 1992	n/a	*canadensis*	n/a	*lanatipes*	*porteri*	ssp. of *canadensis*	n/a
Allred, this paper	*anomalus*	*ciliatus*	*frondosus*	*lanatipes*	*porteri*	*ciliatus*	*lanatipes*

preferred to treat the sections at the generic level; in that case, our species would be assigned to the genus *Bromopsis*.

In reviewing New Mexico specimens of *Bromus* I was bewildered by the amount of variation in the native perennial species of the section *Pnigma*. Identification was close to guesswork, based arbitrarily on which of several features I chose to emphasize. There was a confusing absence of correlation among the numerous features that have been used to identify the species. A resort to the literature only added to the confusion (Table 1). Recent works from adjacent areas (Arnow 1987; Cronquist *et al.* 1977; Gould 1975; Soderstrom & Beaman 1968; Weber 1987, 1990) aided somewhat, but not all the same species were treated as occur in New Mexico. There was also a lack of agreement in the literature on which species occurred in New Mexico. For example, the most recent floristic work for the state (Martin & Hutchins 1980) listed *Bromus purgans* L. as occurring in New Mexico, and many specimens keyed to that entity, but other works (Hitchcock & Chase 1951; Wagnon 1952) excluded that species from the state.

The resolution of all the taxonomic problems in this species complex was beyond the scope of this study. My goals were to conduct an evaluation of the variation present in New Mexico populations of *Bromus* section *Pnigma*, and to provide a reasonable alignment of the variation with the appropriate names. This at least would allow consistent identification of New Mexico

Table 2. Tentative *a priori* grouping of New Mexico *Bromus* specimens.

Group 1: Collars glabrous, pedicels and glumes glabrous, first glume 1 nerved, lemmas pubescent across the back. (16 specimens)

Group 2: Collars ciliate at the corners, pedicels and glumes glabrous, first glume 1 nerved, lemmas pubescent on the margin. (46 specimens)

Group 3: Collars glabrous, pedicels and glumes glabrous, first glume 3 nerved, lemmas pubescent across the back. (18 specimens)

Group 4: Sheaths lanate, collars ciliate at the corners, first glume 1 nerved, lemmas pubescent across the back. (26 specimens)

Group 5: Collars glabrous, pedicels and glumes puberulent, first glume 3 nerved, lemmas pubescent across the back. (34 specimens)

Table 3. Features scored for data analysis of New Mexico *Bromus*.

Sheath pubescence (glabrous, lightly pilose/hirtellous/lanate)

Collar pubescence (glabrous, ciliate at corners)

Panicle length (cm)

Pedicel pubescence (glabrous, puberulent)

Glume pubescence (glabrous, puberulent)

Number of nerves on glume one

Lemma pubescence (on margin, across back)

Lemma length (mm)

Anther length (mm)

Table 4. Correlations above 0.4 among features of New Mexico *Bromus*

Pedicel pubescence × glume pubescence	0.9409
Collar pubescence × glume nervation	-0.6980
Sheath pubescence × collar pubescence	0.5774
Sheath pubescence × lemma length	0.5107
Glume pubescence × glume nervation	0.4416
Lemma pubescence × awn length	0.4330
Sheath pubescence × glume nervation	0.4328
Pedicel pubescence × glume nervation	0.4235

material based on some understandable set of criteria.

METHODS

Approximately 470 New Mexico specimens of *Bromus* belonging to section *Pnigma* were examined. Of these, 140 were selected for data analysis. These specimens were chosen to represent all phases of variation that were found, including not only variation considered typical of recognized species, but also variation that was intermediate or not assignable to species. After careful examination of all 470 specimens, each of the 140 specimens was assigned tentatively to one of five *a priori* groups based on patterns perceived intuitively (Table 2). Several specimens did not correspond exactly to only one of the groups, being intermediate between two groups, but were placed arbitrarily in what was judged to be the closest group. The 140 specimens were also scored for nine morphological features (Table 3). Various statistical procedures (Hintze 1987) were then used to assess the variation patterns and morphological relationships. Discriminant analysis tested the statistical validity of the five *a priori* groups, comparing the overall quantitative similarity of the specimens with their assignments to a particular group.

Names were assigned by consulting type specimens, when available, and the original descriptions of each taxon, as well as the nomenclatural discussions in Baum (1967), McNeill (1976), Soderstrom & Beaman (1968), and Wagnon (1952).

RESULTS OF THE DATA ANALYSIS

A correlation matrix revealed limited correlations among the features. The eight highest correlations are listed in Table 4. Of the features examined, pubescence patterns, number of nerves on the first glume, lemma length, and anther length should be the most useful in pattern recognition.

Fig. 1. Variation in lemma length
(Range, mean, +/− std. dev.)

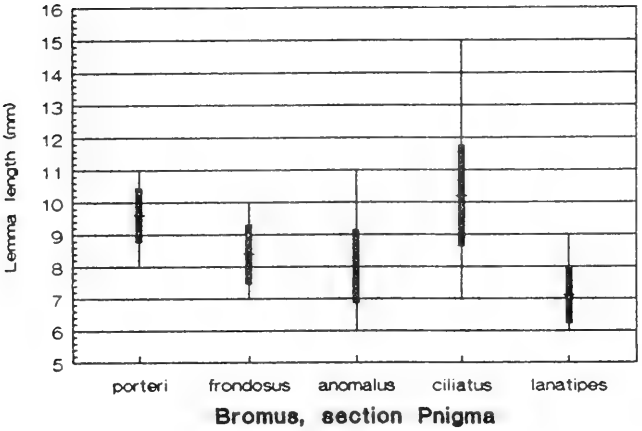
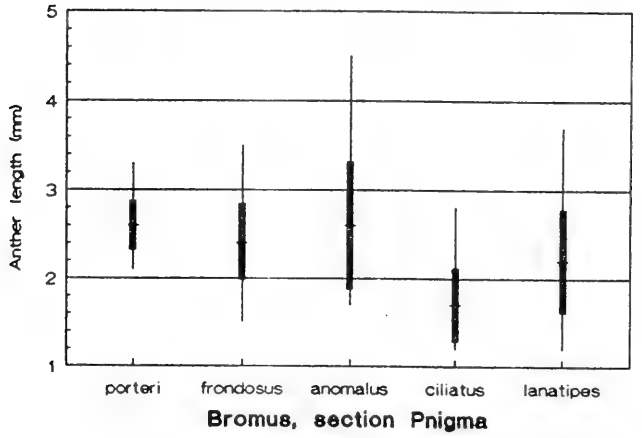


Fig. 2. Variation in anther length
(Range, mean, +/− std. dev.)



Only five of the 140 specimens were judged to be statistically misclassified by the discriminant analysis. All five misclassifications were from group 2: two were assigned by the analysis to group 3, two to group 4, and one to group 5. None of the other groups contained misclassifications. The statistical variation present in the dataset supported the *a priori* classification of 96% of the specimens. Also, the classification error was reduced by 95.5% over what it would be if the specimens had been classified randomly.

The five misclassified specimens were then reclassified, according to the discriminant function, and a second discriminant analysis tested the revised classification. From this second analysis, only two specimens were misclassified, again from group 2; they were both assigned to group 4 by the discriminant function. The revised classification was statistically valid for 98.5% of the specimens, and the classification error was reduced by 98.2%.

The revised groups were characterized as follows:

Group 1: Sheaths not lanate, glabrous to puberulent; collars glabrous at the corners; panicles 7-15 cm long; pedicels puberulent; glumes puberulent; first glume trinerved; lemmas pubescent across the back, 8-11 mm long; anthers 2.1-3.3 mm long. = *Bromus porteri* (Coulter) Nash

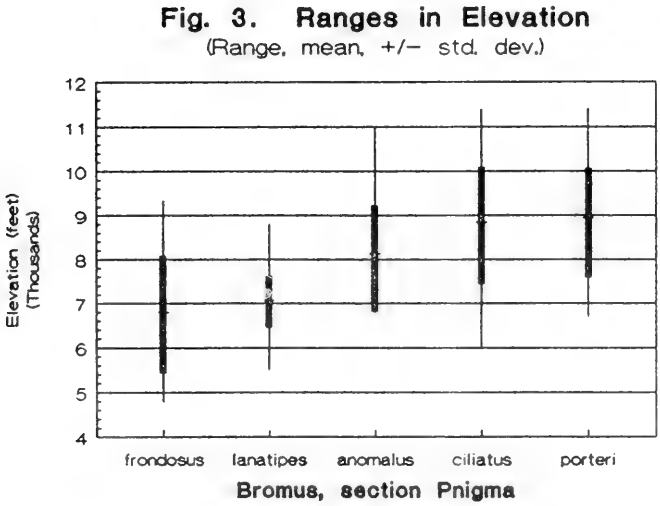
Group 2: Sheaths not lanate, glabrous to puberulent or sparsely pilose; collars glabrous or occasionally with ciliate hairs at the corners; panicles 7-28 cm long; pedicels glabrous; glumes glabrous; first glume trinerved or rarely 1 or 2 nerved; lemmas pubescent on the margins or across the back, 7-10 mm long; anthers 1.5-3.5 mm long. = *Bromus frondosus* (Shear) Wooton & Standley

Group 3: Sheaths not lanate, glabrous to puberulent; collars glabrous at the corners; panicles 8-24 cm long; pedicels glabrous; glumes glabrous; first glume 1 nerved or rarely 2 nerved; lemmas mostly pubescent across the back or occasionally on the margins only, 6-11 mm long; anthers 1.7-4.5 mm long. = *Bromus anomalus* Ruprecht *ex* Fournier

Group 4: Sheaths not lanate, glabrous to pilose; collars with ciliate hairs at the corners; panicles 6-18 cm long; pedicels glabrous; glumes glabrous, first glume 1 nerved or occasionally 2 nerved; lemmas pubescent on the margins or rarely across the back, 7-15 mm long; anthers 1.2-2.8 mm long. = *Bromus ciliatus* Linnaeus

Group 5: Sheaths (mainly the lower) lanate or occasionally densely pilose; collars ciliate to lanate at the corners; panicles 5-15 cm long; pedicels puberulent or rarely glabrous; glumes glabrous or sparsely pilose; first glume 1 nerved or rarely 3 nerved; lemmas pubescent across the back or occasionally on the margin, 6-9 mm long; anthers 1.2-3.7 mm long. = *Bromus lanatipes* (Shear) Rydberg

Nearly all of the *Bromus* specimens from New Mexico available to me agreed with one of these five groups. As in the statistical analysis, a small fraction of specimens (about 22 of 470) were intermediate between group 2 (*B. frondosus*) and groups 3 or 4.



Variation in lemma length is displayed in Figure 1. *Bromus lanatipes* had the smallest lemmas and *B. ciliatus* the largest. Even though the ranges overlapped, the means of three groups of species were significantly different ($P < 0.05$): *B. lanatipes*, *B. porteri/B. ciliatus*, and *B. frondosus/B.anomalus*.

Bromus porteri, *B. frondosus*, and *B. anomalus* all had similar anther lengths (Figure 2), and the means were not significantly different. *Bromus ciliatus*, however, had the smallest anthers, and the means of *B. ciliatus* and *B. lanatipes* were significantly different ($P < 0.05$), both from each other and from the other three taxa.

Examination of label data revealed a cline in elevation of habitats for the species (Figure 3). There is rather extensive overlap of the overall ranges in elevation, although the means of the lower elevational species (*Bromus frondosus* and *B. lanatipes*), the midelevational (*B. anomalus*), and the upper elevational (*B. porteri* and *B. ciliatus*) were significantly different ($P < 0.05$). Elevation cannot completely discriminate among the species, but they do tend to occupy habitats at different altitudes.

Recent works (Cronquist *et al.* 1977; Martin & Hutchins 1980; Arnow 1987) have relegated *Bromus porteri* and *B. frondosus* to synonymy without rank under *B. anomalus*. The two species *B. porteri* and *B. anomalus* are rather clearly separated, however, by differences in pedicel and glume pubescence and in glume nervature, as well as by a strong tendency to occupy habitats at

different elevations. Discrimination of *B. frondosus* is much less precise, being based mostly on differences in glume nervature. Recognition of *B. frondosus* at the specific level may prove to be unwarranted, but, relying on the results of the discriminant analysis, I will continue to recognize this species until studies are reported that clarify the relationship.

Martin & Hutchins (1980) referred New Mexico specimens with long panicles, pilose sheaths, and lemmas pubescent either across the back or on the margins to *Bromus purgans* L., a name that has been a consistent source of confusion for nearly the past century (see Baum 1967, and McNeill 1976). Baum (1967) proposed the correct application of the name, but its usage was never taken up in any general taxonomic works, and McNeill (1976) provided a correct neotypification. I follow McNeill (1976) in rejecting the name *Bromus purgans* L. as a *nomen confusum*. New Mexico material previously referred to this name aligns with *B. lanatipes* or *B. ciliatus*.

IDENTIFICATION AND TAXONOMY

Bromus Linnaeus, *Sp. Pl.* 76. 1753.
(*Anisanthus* C. Koch, *Bromopsis* Fourn., *Ceratochloa* Beauv.)

Annuals, biennials, or perennials. Culms hollow. Sheaths closed to near the top; ligules membranous; auricles present or absent. Inflorescence a panicle. Spikelets with several florets, disarticulating above the glumes and between the florets; glumes mostly unequal, shorter than the lowermost lemma, the first 1 to 3 nerved, the second 3 to 5 nerved; lemmas mostly 5 to 9 nerved, usually awned from just below the apex; palea 2 nerved, adhering to the caryopsis at maturity. Stamens usually 3. $x = 7$.

A key is presented to all species of *Bromus* in New Mexico, followed by descriptions of the native species of section *Pnigma*

1. Plants perennial.

    2. Rhizomes present (section *Pnigma*, introduced species). .... *B. inermis* Leysser [*Bromopsis inermis* (Leysser) Holub].

        3. Spikelets and sheaths glabrous; awns 0-1 mm long. .... var. *inermis*.

        3. Spikelets and sheaths pubescent; awns 2-3 mm long. .... var. *purpurascens* (Hooker) Wagnon [*B. pumpellianus* Scribn., *Bromopsis pumpelliana* (Scribn.) Holub]. This is apparently the native counterpart to the introduced *B. inermis*.

    2 Rhizomes absent.

4. Spikelets strongly flattened, the lemmas v-shaped in cross-section; second (upper) glume mostly 5 to 7 nerved.
   5. Lemma awns 0-2.5 mm long. .... *B. catharticus* Vahl [*B. unioloides* (Willd.) H.B.K., *B. willdenovii* Kunth].
   5. Lemma awns 3-8 mm long (rarely as short as 2 mm). ... . *B. carinatus* Hooker & Arnott [*Ceratochloa carinata* (Hooker & Arnott) Tutin]. The following weak races have been recognized.
      6. Plants annual or biennial, 30-100 cm tall; awns usually more than 7 mm long. ..... the *carinatus* race.
      6. Plants perennial, 80-120 cm tall; awns usually less than 7 mm long.
         7. Plants mostly hairy throughout ....the *marginatus* race [*B. marginatus* Steudel].
         7. Plants mostly hairless, at least in the spikelets. ... .the *polyanthus* race [*B. polyanthus* Scribner].
4. Spikelets not strongly flattened, but more or less terete, the lemmas rounded on the back in cross section; second (upper) glume 3 nerved (section *Pnigma*, native species).
   8. First glume 3 nerved, the lateral nerves occasionally short.
      9. Glumes and pedicels puberulent; lemmas pubescent across the back; blades erect, the midrib not narrowed below the collar. ..... *B. porteri.*
      9. Glumes and/or pedicels glabrous; lemmas pubescent across the back or on the margins only; blades mostly lax or spreading, the midrib often narrowed below the collar. ..... *B. frondosus.*
   8. First glume 1(-2) nerved.
      10. Sheaths lanate or densely pilose, the hairs spreading from the sheath but becoming matted at the tips; lemmas mostly less than 8 mm long. .....*B. lanatipes.*
      10. Sheaths glabrous to lightly pilose or hirtellous, if hairy then not becoming matted; lemma length various, but mostly 7-12 mm long.
         11. Sheaths with crinkled hairs at the corners of the collars; lemmas densely hairy on the margins but glabrous or nearly so on the median portion across the back; anthers mostly shorter than 2.2 mm; lemmas mostly longer than 8.6 mm. .....*B. ciliatus.*

11. Sheaths glabrous at the collars; lemmas hairy across the back, not glabrous on the median portion; anthers mostly longer than 1.8 mm; lemmas mostly shorter than 9.2 mm. ..... *B. anomalus.*

1. Plants annual.

12. Lemma awns 0-2.5 mm long.

13. Lemmas lanceolate, broadest at the base, 9-14 mm long; anthers about 3-4 mm long. ..... *B. catharticus* Vahl (*B. unioloides* [Willd.] H.B.K., *B. willdenovii* Kunth).

13. Lemmas inflated, broadest at the middle, 7-9 mm long; anthers 1 mm long or less. .. *B. briziformis* Fisch. & Mey.

12. Lemma awns longer than 3 mm.

14. Lemmas 6-9(-10) mm long at maturity.

15. Awns mostly less than 5 mm long; lemmas rounded, the margins usually rolled around the grain; plants hairless. ..... *B. secalinus* L.

15. Awns mostly more than 5 mm long; lemmas somewhat flattened, the margins not rolled around the grain; plants hairy.

16. Panicles dense, compact, 3-8(10) cm long, the branches stiffly erect. ... *B. hordeaceus* L. The following weak races have been recognized:

17. Awns flattened at the base, divaricate when mature. . ..... the *molliformis* race [*B. molliformis* Lloyd].

17. Awns round at the base, straight or curving slightly outward when mature. .... the *hordeaceus* race [*B. mollis* L.].

16. Panicles open, 6-20 cm long, the branches spreading. ... . *B. japonicus* Thunb. *ex* Murray. The following weak races have been recognized:

18. Panicle branches lax and drooping; awns flattened at the base; anthers 0.8-1.5 mm long; hairs on leaf sheaths spreading or reflexed, soft and becoming matted on handling. ..... the *japonicus* race.

18. Panicle branches stiffly ascending or spreading; awns round at the base; anthers 1.5-2.0 mm long; hairs on leaf sheaths reflexed, straight. .... the *commutatus* race [*B. commutatus* Schrad.].

14. Lemmas (9-)10-30 mm long at maturity.

19. First glume 3 to 5 nerved; awns 4-8 mm long. . . . . *B. carinatus* Hook. & Arn. See leads 6-7 to distinguish the races of this species.

19. First glume mostly 1 nerved (occasionally 3 nerved in *B. diandrus*); awns (7-)10-60 mm long.

20. Panicle dense, compact, ovoid; panicle branches stout, erect, and mostly much shorter than 2 cm. . . . . *B. rubens* L.

20. Panicle loose, open, elongate; panicle branches often spreading or drooping, and mostly much longer than 2 cm.

21. Awns mostly 3-6 cm long; lemmas 20-35 mm long. . . . . *B. diandrus* Roth [*B. rigidus* of numerous authors, *Anisantha diandra* (Roth) Tutin].

21. Awns mostly 1-3 cm long; lemmas 9-20 mm long.

22. Primary panicle branches mostly with 1(3) spikelets; awns 15-30 mm long; lemmas 14-20 mm long. . . . *B. sterilis* L. [*Anisantha sterilis* (L.) Nevski].

22. Primary panicle branches mostly with more than 3 spikelets, at least on mature shoots; awns 10-18 mm long; lemmas 9-12 mm long. . . . . *B. tectorum* L. [*Anisantha tectorum* (L.) Nevski].

Bromus anomalus Ruprecht *ex* Fournier NODDING BROME, BROMO DORMILON. Fig. 4.

Bromus anomalus Rupr. *in* Galeotti, Bull. Acad. Roy. Brux. 9(2):236. 1842. *Nomen nudum. Bromus anomalus* Rupr. *ex* Fourn., *Mex. Pl.* 2:126. 1886. *Zerna anomala* (Rupr. *ex* Fourn.) Henrard, Blumea 4:499. 1941. *Bromopsis anomala* (Rupr. *ex* Fourn.) Holub, Folia Geobot. Phytotax., Praha 8:167. 1973.

Bromus lanatipes (Shear) Rydb. forma *glaber* Wagnon, Leafl. West. Bot. 6:68. 1950.

Description: Culms 45-110 cm tall, erect, unbranched above the base; nodes mostly 4-6, glabrous or rarely sparsely retrorsely pubescent. Sheaths

glabrous to sparingly pilose or hirtellous, shorter than the internodes; ligules 1 mm or less long; auricles absent, the collars glabrous at the corners; blades 12-26 cm long, 3-7 mm wide, flat, glabrous or occasionally lightly hirtellous, the midrib narrowed just below the collar. Panicles 8-24 ($\bar{x} = 16$) cm long, well exserted from the sheath, open; primary branches 5-9 cm long, erect to divaricate, naked at the base. Spikelets 1.8-3.3 cm long, with 4-12 florets; pedicels glabrous; first glume 1-nerved (rarely 2 nerved), glabrous to rarely sparsely hirtellous; lemmas 6-11 ($\bar{x} = 8.0$) mm long, shortly pilose on the margins and across the back between the nerves, occasionally on the margins only; lemma awns 1-4 mm long. Anthers 1.7-4.5 ($\bar{x} = 2.6$) mm long. $2n = 14$.

Habitat: Mountain scrub, oak and piñon/juniper woodlands, ponderosa parklands, aspen groves, mountain meadows and edges of coniferous forest, often in the shaded understory; 6800-11,000 ft (2100-3350 m) elevation, but mostly below 9200 ft (2800 m).

Wagnon (1950) named what he considered glabrous sheathed *Bromus lanatipes* as forma *glaber*. The type (New Mexico: Santa Fe Co.: Santa Fe Cañon, 9 miles east of Santa Fe, 8000 ft, 12 July 1897, *A.A. & E. Gertrude Heller 3895*, NY!), from mountain pine forests typical of *B. anomalus*, is indistinguishable from the latter species. *Bromus lanatipes* is unknown from Santa Fe County.

Bromus ciliatus Linnaeus FRINGED BROME, BROMO HIRSUTO. Figs. 5-7.

Bromus ciliatus L., *Sp. Pl.* 1:76. 1753. *Bromus inermis* Leysser var. *ciliatus* (L.) Traut., Acta Hort. Petrop. 5:135. 1877. *Bromus hookeri* Fourn. var. *ciliatus* (L.) Fourn., *Mex. Pl.* 2:128. 1886. *Forasaccus ciliatus* (L.) Lunell, Amer. Midl. Nat. 4:225. 1915. *Zerna ciliata* (L.) Henrard, Blumea 4:498. 1941. *Bromopsis ciliata* (L.) Holub, Folia Geobot. Phytotax., Praha, 8:167. 1973.

Bromus ciliatus L. forma *denudatus* Wiegand, Rhodora 24:91. 1922. *Bromus ciliatus* L. var. *denudatus* (Wiegand) Fernald, Rhodora 28:20. 1926.

Bromus canadensis Michx., *Fl. Bor.-Amer.* 1:65. 1803. *Bromus hookeri* Fourn. var. *canadensis* (Michx.) Fourn., *Mex. Pl.* 2:128. 1886. *Bromopsis canadensis* (Michx.) Holub, Folia Geobot. Phytotax., Praha, 8:167. 1973.

Bromus richardsonii Link, *Hort. Berol.* 2:28. 1833. *Bromopsis richardsonii* (Link) Holub, Folia Geobot. Phytotax., Praha, 8:168. 1973.

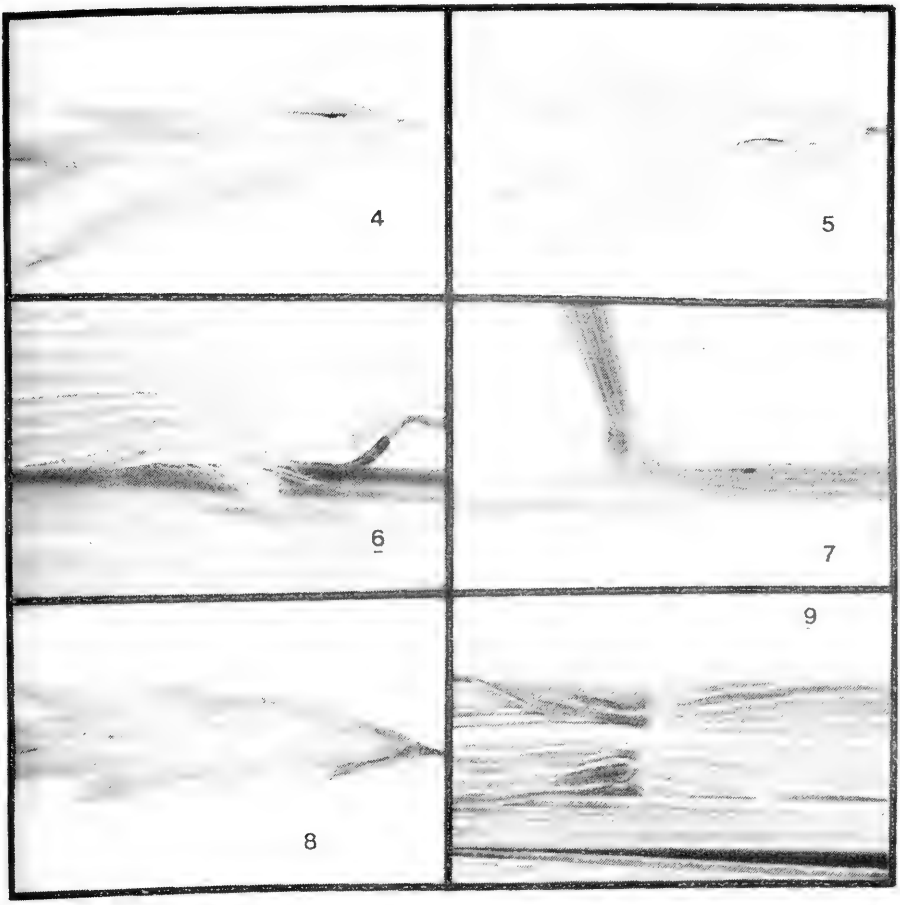


Figure 4. *Bromus anomalus*, spikelet (× 4.5).
Figure 5. *Bromus ciliatus*, spikelet (× 4.7).
Figure 6. *Bromus ciliatus* (glabrous foliage), ciliate collar (× 12).
Figure 7. *Bromus ciliatus* (hairy foliage), ciliate collar (× 3).
Figure 8. *Bromus frondosus*, spikelet (× 4.5).
Figure 9. *Bromus frondosus*, collar, showing narrowed midrib (× 9.5).

Bromopsis canadensis Michx. subsp. *richardsonii* (Link) Tzvelev, Poaceae, URSS, 1:214. 1976.

Description: Culms 50-140 cm tall, erect, unbranched from the base; nodes mostly 4-7, mostly glabrous, but occasionally retrorsely pubescent. Sheaths glabrous to sometimes lightly hirtellous, shorter than the internodes; ligules 0.5-3.5 mm long; auricles absent, the collars with a tuft of hairs at the corners; blades 12-35 cm long, 3-9 mm wide, flat, glabrous or occasionally sparsely hirtellous on the upper surface, the midrib narrowed below the collar. Panicles 6-18 ($\bar{x} = 11$) cm long, well exserted from the sheath, open or occasionally loosely contracted; primary branches 6-12 cm long, spreading to divaricate, occasionally ascending or erect. Spikelets 1.8-4.0 cm long, with 5-14 florets; pedicels glabrous; first glume 1 nerved, occasionally 2 nerved, glabrous; lemmas 7-15 ($\bar{x} = 10.2$) mm long, pubescent on the margin and glabrous across the back, only rarely pubescent across the back; lemma awns 3-5 mm long. Anthers 1.2-2.8 ($\bar{x} = 1.7$) mm long. $2n = 14, 28$.

Habitat: Sparingly in oak or piñon/juniper woodlands, more common at higher elevations in piñon and ponderosa woodlands, mountain meadows, and grassy slopes in the spruce/fir zone; 6000-11,400 ft (1800-3500 m) elevation.

Wagnon (1952) distinguished *Bromus ciliatus* and *B. richardsonii* by ploidy level, anther size, and the pubescence of the blades, collars, and nodes. Although many New Mexico specimens correspond to Wagnon's concept of *B. richardsonii*, the morphological features either intergrade or are not correlated (particularly anther size and collar pubescence) and I follow Arnow (1987), Cronquist *et al.* (1977), Soderstrom & Beaman (1968), and Weber (1987, 1990) in recognizing *B. ciliatus* in the more inclusive sense.

Specimens of *Bromus ciliatus* with hairy sheaths have been confused with *B. lanatipes*. The hairs of the former are stiffly hirsute, rather sparse, and do not form a mat of tangled ends (Fig. 7). The hairs of the latter are densely pilose to lanate, forming a mat of tangled ends (Fig. 11).

I accept the neotypification of the well known epithet *Bromus ciliatus* Linnaeus by McNeill (1976), which obviates the use of *B. canadensis* Michaux for fringed brome (Baum 1967).

Bromus frondosus (Shear) Wooton & Standley WEEPING BROME, BROMO FRONDOSO. Figs. 8-9.

Bromus porteri Nash var. *frondosus* Shear, USDA Div. Agrost. Bull. 23:37. 1900. *Bromus frondosus* (Shear) Woot. & Standl., New Mexico Exp. Sta. Bull. 81:144. 1912. *Bromopsis frondosa* (Shear) Holub, Folia Geobot. Phytotax., Praha 8:167. 1973.

Description: Culms 26-98 cm tall, erect, unbranched above the base; nodes 3-6, glabrous. Sheaths glabrous to puberulent or sparsely pilose, shorter than the internodes; ligule less than 1 mm long; auricles absent, the collars glabrous at the corners or occasionally with ciliate hairs; blades 9-22 cm long, 2.5-5.0 mm wide, flat or loosely folded, lax or loosely spreading, glabrous or the basal blades puberulent, the midrib usually narrowed below the collar. Panicles 7-28 ($\bar{x} = 15$) cm long, well exserted from the sheath, open to loosely contracted; primary branches 4-12 cm long, ascending to spreading or less commonly divaricate-reflexed. Spikelets mostly 2-3 cm long, with 5-12 florets; pedicels glabrous; glumes glabrous; first glume 3 nerved or rarely 1 or 2 nerved; lemmas 7-10 ($\bar{x} = 8.4$) mm long, pubescent across the back or on the margins only; lemma awns 2-5 mm long. Anthers 1.5-3.5 ($\bar{x} = 2.4$) mm long. $2n = 14$.

Habitat: Semidesert mountain scrub and riparian areas, mountain brush, oak/juniper and pine/oak woodlands, ponderosa/juniper forests; 4800-9400 ft (1500-2900 m) elevation, but mostly below 8100 ft (2500 m).

Bromus frondosus may grade into both *B. anomalus* and *B. ciliatus*. This is the least distinct of the five species treated here, and perhaps should be merged with one of the above. *Bromus porteri* is distinguished by its puberulent pedicels and glumes, erect blades, and a midrib that is not narrowed at the collar (compare Figs. 9 and 13).

Bromus lanatipes (Shear) Rydberg SHAGGY BROME, BROMO VELLUDO. Figs. 10-11.

Bromus porteri Nash var. *lanatipes* Shear, USDA Div. Agrost. Bull. 23:37. 1900. *Bromus lanatipes* (Shear) Rydb., Colo. Exp. Sta. Bull. 100:52. 1906. *Bromus anomalus* Rupr. *ex* Fourn. var. *lanatipes* (Shear) A.S. Hitchc., J. Wash. Acad. Sci. 23:449. 1933. *Bromopsis lanatipes* (Shear) Holub, Folia Geobot. Phytotax., Praha 8:168. 1973.

Bromus mucroglumis Wagnon, Leafl. West. Bot. 6:67-68. 1950. *Bromopsis mucroglumis* (Wagnon) Holub, Folia Geobot. Phytotax., Praha, 8:168. 1973.

Description: Culms 35-85 cm tall, erect, unbranched above the base; nodes retrorsely puberulent or occasionally glabrous. Sheaths (especially the lower) lanate or sometimes only densely pilose, the hairs spreading but matted at the tips, often longer than the internodes except on very elongate culms; ligules 1-2 mm long; auricles absent, the collars ciliate to lanate at the corners; blades 10-30 cm long, (2-)3-7 mm wide, flat, glabrous, the midrib narrowed below the

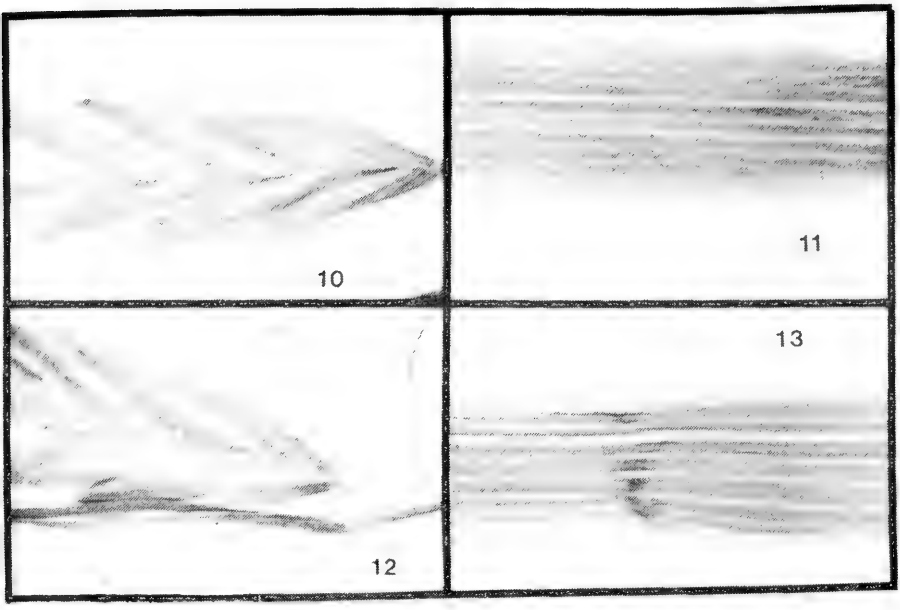


Figure 10. *Bromus lanatipes*, spikelet (× 4.6).
Figure 11. *Bromus lanatipes*, sheath (× 10).
Figure 12. *Bromus porteri*, spikelet & pedicels (× 4.2).
Figure 13. *Bromus porteri*, collar, showing midrib not narrowed (× 10).

collar. Panicles 5-15 ($\bar{x} = 11$) cm long, loosely contracted to somewhat open; primary branches 5-9 cm long, erect to ascending. Spikelets 1.5-3.0 cm long, with 5-14 florets; pedicels puberulent or rarely glabrous; glumes glabrous to sparsely pilose; first glume 1 nerved or rarely 3 nerved; lemmas 6-9 ($\bar{x} = 7.1$) mm long, pubescent across the back or occasionally on the margins only; lemma awns 2-4 mm long. Anthers 1.2-3.7 ($\bar{x} = 2.2$) mm long. $2n = 28$.

Habitat: Semidesert riparian areas and mountain brush, juniper plains and woodlands, piñon/juniper and juniper/oak woodlands; 5400-8800 ft (1600-2700 m) elevation.

Wagnon (1950, 1952) based *Bromus mucroglumis* Wagnon on pubescent sheaths and glumes, 1 nerved first glumes, mucronate second glumes, and lemmas pubescent across the back. For the most part, these features agree with *B. lanatipes*, or with disparate specimens of *B. anomalus* having hairy glumes. The type specimen of *B. mucroglumis* lacks any basal material, but the pubescence of the upper sheaths, glumes, and florets are consistent with *B. lanatipes*.

Bromus lanatipes forma *glaber* is subsumed under *B. anomalus*, q.v.

Other species, particularly *Bromus ciliatus*, may have hairy sheaths. The sheath pubescence of *B. lanatipes* is distinct, however, by being densely pilose or lanate with matted ends, rather than stiffly hirtellous (compare Figs. 7 & 11).

This is the least diverse of the species in terms of habitat and ecological amplitude. Most plants occupy relatively dry habitats in the piñon/juniper/oak zones between 6500 and 7600 ft (1900-2300 m).

Bromus porteri (Coulter) Nash PORTER'S BROME, BROMO DE PORTER. Figs. 12-13.

Bromus kalmii A. Gray var. *porteri* Coult., *Man. Bot. Rocky Mts. Reg.* 425. 1885. *Bromus ciliatus* L. var. *porteri* (Coult.) Rydb., Contr. U.S. Nat. Herb. 3:192. 1895. *Bromus porteri* (Coult.) Nash, Bull. Torrey Bot. Club 22:512. 1895. *Bromopsis porteri* (Coult.) Holub, Folia Geobot. Phytotax., Praha 8:168. 1973.

Description: Culms 36-120 cm tall, erect, unbranched above the base; nodes 3-5, glabrous or retrorsely puberulent. Sheaths glabrous to puberulent, shorter or longer than the internodes; ligules 1-3 mm long; auricles absent, the collars glabrous at the corners; blades 10-36 cm long, 3-12 mm wide, mostly stiffly erect, the midrib not narrowed below the collar, glabrous. Panicles 7-15 ($\bar{x} = 11$) cm long, open or occasionally loosely congested; primary branches 4-10 cm long, ascending to loosely spreading, rarely divaricate. Spikelets 1.8-3.0 cm long, with 5-12 florets; pedicels puberulent; glumes puberulent; first

glume 3 nerved; lemmas 8-11 ($\bar{x} = 9.6$) mm long, pubescent across the back; lemma awns 1.5-4.0 mm long. Anthers 2.1-3.3 ($\bar{x} = 2.6$) mm long. $2n = 14$.

Habitat: Ponderosa parklands, aspen groves, mixed conifer forests, high mountain meadows, openings in spruce/fir forests; 6800-11,400 ft (2100-3500 m) elevation.

This is perhaps the most distinct species in this complex, with puberulent and 3 nerved glumes, puberulent pedicels, and stiffly erect blades. The glume and pedicel pubescence were highly correlated in the statistical analysis.

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The curators of NMC, UNM, and US generously made available their facilities and allowed me to borrow specimens. John Mosley helped with the data accumulation and analysis. Rex Pieper and Richard Spellenberg offered constructive comments on the manuscript. This paper is a contribution from the New Mexico Agricultural Experiment Station.

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Bromus anomalus: BERNALILLO Co.: Mesa, north of Albuquerque, 24 Sep 1959, *Caudill, M. 23* (UNM). CATRON Co.: Redstone Park, Trail 206, 4 Sep 1976, *Spellenberg, R., J. Reitzel, D. Hill 4493* (NMC); Eagle Peak, 9750 ft (2972 m), 23 Jul 1986, *Spellenberg, R., C. Barrera 8571* (NMC); Madre Mt, Blue Springs area, 10 Oct 1955, *Potter, L.D. 105* (UNM); Mogollon Mts, Apache Spring, spruce forest, 10,000 ft (3048 m), 23 Aug 1968, *Hess, W. 2275* (NMC); Mogollon Mts, Iron Creek Canyon, 7760 ft (2365 m), 21 Jul 1978, *Moir, W.H. & E.L. Fitzhugh 310* (NMC). CIBOLA Co.: Rock ledge, Zuni Mts, 8640 ft (2633 m), 7 Sep 1968, *Riffle, N.L.* (UNM); La Mosca Lookout, Mt. Taylor, 11000 ft (3353 m), 27 Jul 1952, [no collector] *2707* (UNM). DONA ANA Co.: Filmore Canyon, Organ Mts, 23

Sep 1906, *Wooton, E.O. s.n.* (NMC); Filmore Canyon, Organ Mts, 20 Sep 1908, *Wooton, E.O., P. Standley s.n.* (NMC); Old Tiptop, Organ Mts, 18 Oct 1903, *Metcalfe, O.B. s.n.* (NMC). GRANT Co.: Gallinas Campground along road from San Lorenzo to Hillsboro, 5 Aug 1988, *Allred, K.W. 4832* (NMCR); Mimbres Mts, McKnight Mt, 26 Sep 1987, *Allred, K.W. 4651* (NMCR). HARDING Co.: Spring, east side of Canadian River, 5500 ft (1676 m), 30 Jun 1981, *Fletcher, R. 5271* (UNM). HIDALGO Co.: Peloncillo Mts, along Geronimo Trail, 5 Sep 1987, *Allred, K.W. 4584* (NMCR). LINCOLN Co.: Sierra Blanca, 4.2 mi. W of Alto, 28 Aug 1976, *Wagner, W.L. & D. Sabo 2526* (UNM); White Mts, 7400 ft (2256 m), 25 Aug 1907, *Wooton E.O., Standley, P. 3568* (NMC). LOS ALAMOS Co.: Water Canyon, ponderosa-pinyon area, 6500 ft (1981 m), 31 Aug 1977, *Tierney G. & T. Foxx 36* (UNM); Frijoles Canyon, Bandelier Nat. Mon., 1 Aug 1941, *Clark, O.M. 9962* (UNM); Pajarito Canyon, 6750 ft (2057 m), 24 Jul 1979, *Foxx & Tierney 385* (UNM). RIO ARRIBA Co.: Gallinas Canyon, 9 Aug 1936, *Nisbet, G. 8268* (UNM). SAN JUAN Co.: Chaco Canyon National Monument, 29 May 1987, *Allred, K.W. 4392* (NMCR). SAN MIGUEL Co.: Panchuela Creek, 8500 ft (2591 m), 16 Jul 1908, *Standley, P.C. 4361* (NMC); Barillas Peak, mixed conifer, *Perry, J.L. 16* (UNM); Cowles, 4 mi. south, 16 Jul 1949, *Castetter & Dittmer 2706* (UNM). SANDOVAL Co.: Upper Las Huertas canyon, Sandia Mts, 24 Sep 1960, *Dixon, H.N. 159* (UNM); Las Huertas Creek road, Sandia Mts, 7000 ft (2134 m), 18 Sep 1982, *Dunbar, T. 338* (UNM). SIERRA Co.: Beaverhead, Taylor Creek, 7400 ft (2256 m), 14 Aug 1982, *Spellenberg R., R. Soreng, & R. Wahl 6599* (NMC); Timber Mt, Caballo Range, 20 Aug 1986, *Allred, K.W. 4216* (NMCR). SOCORRO Co.: Water Canyon, 16 Jul 1897, *Herrick, C.L. 744* (NMC); Mogollon Mts, Mogollon Creek, 8000 ft (2438 m), 26 Jul 1903, *Metcalfe, O.B. 327* (NMC); Magdalena Mts, South Canyon, 8000 ft (2438 m), 28 Jul 1973, *Hutchins, B. 4582* (UNM); Magdalena Mts., Forest road 235, 9320 ft (2841 m), 21 Aug 1978, *Moir, W.H. & E.L. Fitzhugh 671* (NMC); Monica Ranger Station, pinyon-juniper, 7400 ft (2256 m), 11 Oct 1955, *Potter, L.D. 158* (UNM); Water Canyon, 16 Jul 1897, *Herrick, C.L. 742* (NMC); Water Canyon, 3 Sep 1964, *Powers, W.H. 14* (UNM). TAOS Co.: Red River Village, rocky hillside, 8600 ft (2621 m), 13 Aug 1955, *Castetter, E.L. 9826* (UNM); Red River, 11 Jun 1937, *Hare, Q.A. 1886* (NMCR); Costilla Canyon, spruce hillside, 18 Jul 1953, *Castetter, E.F. 8757* (NMC); Costilla Creek, Sangre De Cristo Mts, 8500 ft (2591 m), 15 Aug 1973, *Holmgren N.H. & P.K. Holmgren 7178* (UNM); Costilla Canyon, spruce hillside, 18 Jul 1953, [no collector] *2700* (UNM). TORRANCE Co.: Manzano Mts. between Bosque Peak and Tajique-Torreon loop road, 8800 ft (2682 m), 26 Aug 1963, *Bedker, E.J. 1410* (UNM).

Bromus ciliatus: BERNALILLO Co.: Kiwanis meadow, Sandia Mts, 10400 ft (3170 m), 23 Sep 1982, *Dunbar, T. 276* (UNM); Open meadow among spruce, Sandia crest, 10000 ft (3048 m), 3 Aug 1952, [no collector] *2705* (UNM); 7.2 mi. NW of Sandia park, dense douglas fir and aspen on limestone, 9450 ft (2880 m), 5 Aug 1949, *Gordon, S. & K. Norris 134* (UNM); Cienega Canyon, Sandia Mts, 30 Sep 1961, *Simms, H.R. 112* (UNM); Open forest meadows, west of road near tree springs, Sandia Mts, 8400 ft (2560 m), 30 Aug 1967, *Jones, C.B. 54-22* (UNM); Woods, Sandia Rim, 10500 ft (3200 m), 18 Sep 1932, *Castetter, E.F. 2709* (UNM); Cienega

Canyon, many trees, herbs, 7800 ft (2377 m), 30 Sep 1961, *Boyd, D.M. 12* (UNM); Hillside heavily forested with *Quercus*, *Juniperus*, *Pinus*, and *Pseudotsuga*, 3.3 mi. SW of Sandia Park, 8000 ft (2438 m), 8 May 1949, *Gordon, S. & K. Norris 109* (UNM); Kiwanis Meadow, Sandia Mts, 10400 ft (3170 m), 2 Aug 1982, *Dunbar, T. 157* (UNM). CATRON Co.: Mogollon Mts. Gilita Campground, 8100 ft (2469 m), 7 Sep 1978, *Moir, W.H. & E.L. Fitzhugh 713* (NMC); 40 mi NW of Pietown, 27 Aug 1936, *Parker, K.W. 1219* (NMCR); 20 mi NE of Reserve, 1939, *Bridges, J.O. 1486* (NMCR); Gila Natl. Forest, Mogollon Mts, Water Canyon, mixed conifer dry riparian, 17 Oct 1984, *Fletcher, R. 7925* (UNM); Gila Natl. For., Luna District, Rd 209, 1 mi NE of jct Rd 4 (Nolan Canyon Rd), 11 Sep 1982, *Allred, K.W. 2361* (NMCR); Trail Canyon, Apache Natl. Forest, 7400 ft (2256 m), 8 Aug 1960, *Reimers, M.A. 19* (UNM); Reserve on Eagle Peak, fir/aspen woods, 9750 ft (2972 m), 23 Jul 1986, *Spellenberg, R. & C. Barrera 8570* (NMC); 5 mi E of Mogollon, 7 Sep 1936, *Parker, K.W. 888* (NMCR); 20 mi S of Beaverhead, 21 Sep 1932, *Parker, K.W. 115* (NMCR); Datil Mts, volcanic soil, 9000 ft (2743 m), 19 Jul 1976, *Fletcher 634* (UNM). CIBOLA Co.: In aspen grove, Mt. Taylor, 10700 ft (3261 m), 22 Jul 1960, *Osborn, N. 422* (UNM); Horace Mesa, 20 mi NE Grants, 12 Sep 1933, *Parker, K.W. 429* (NMCR); W exposure above creek in Lobo Canyon, Mt. Taylor, 8100 ft (2469 m), 15 Jul 1960, *Osborn, N. 218* (UNM); Mt. Taylor, 10800 ft (3292 m), 22 Jul 1960, *Osborn, N. 398* (UNM); Upper Lobo Canyon, Mt. Taylor, 8500 ft (2591 m), 10 Aug 1960, *Osborn, N. 516* (UNM); Upper Lobo Canyon, road to Gooseberry Spring, Mt. Taylor, 8600 ft (2621 m), 25 Aug 1960, *Osborn, N. 606* (UNM); La Mosca Canyon, Mt. Taylor, 20 Jul 1961, *Osborn, N. 753* (UNM); In aspen grove, Mt. Taylor, 10700 ft (3261 m), 22 Jul 1960, *Osborn, N. 422* (UNM); Summit of Mt. Taylor, open area, 11389 ft (3471 m), 23 Jul 1960, *Osborn, N. 439* (UNM). COLFAX Co.: Johnson Mesa, Las Vegas District, Santa Fe Forest, Sandy loam, 22 Sep 1960, *Prichard, L.A. 12* (UNM); Potato Canyon; doug fir/ponderosa pine habitat, 10 Aug 1982, *Jepson, R. 1111* (UNM). DONA ANA Co.: Filmore Canyon, Organ Mts, 6700 ft (2042 m), 29 Oct 1904, *Wooton E.O.* (NMC). GRANT Co.: Hillsboro Peak, 10000 ft (3048 m), 25 Aug 1904, *Metcalfe, O.B. 1251* (NMC); Black Range, McKnight Road, 8700 ft (2652 m), 11 Aug 1978, *Moir, W.H. & E.L. Fitzhugh 638* (NMC); Black Range, near Mimbres Lake, 9600 ft (2926 m), 13 Aug 1978, *Moir, W.H. & E.L. Fitzhugh 646* (NMC); Gila Natl For, Hwy 90, Emory Pass vista, 2 Oct 1982, *Villalobos, M. 31* (NMCR); Hillsboro Peak, among spruce, shady slopes, 10000 ft (3048 m), 25 Aug 1904, *Metcalfe, O.B.* (UNM); Mimbres Mts, McKnight Mt, 26 Sep 1987, *Allred, K.W. 4657* (NMCR); Hillsboro Peak, among spruce, shady slopes, 10000 ft (3048 m), 25 Aug 1904, *Metcalfe, O.B. 1251* (UNM); Gallinas Campground along road from San Lorenzo to Hillsboro, 5 Aug 1988, *Allred, K.W. 4831* (NMCR); Mimbres Mts, McKnight Mt, 26 Sep 1987, *Allred, K.W. 4650* (NMCR). LINCOLN Co.: Lincoln Natl. For., For. Rd 108, 2 Sep 1983, *Allred, K.W. 2550* (NMCR); White Mt. Peak, 10000 ft (3048 m), 1 Aug 1901, *Wooton, E.O. s.n.* (NMC); About 10 mi N of Ruidoso on Sierra Blanca, *Sanchez, J.R. s.n.* (NMCR); Gravel loam of Monjeau Peak, White Mts, south slope, 9641 ft (2939 m), 26 Oct 1968, *Hutchins, B. 1755* (UNM); White Mountains, mountain north of Sierra Blanca Ski Lodge, 9 Oct 1987, *Allred, K.W. 4662* (NMCR); Ruidoso Creek, 3 mi up from Ruidoso, 21 Jul 1935, *Parker, K.W.*

612 (NMCR); Gilmore's Ranch, Eagle Creek, White Mts, 7000 ft (2134 m), 14 Jul 1895, *Wooton, E.O.* (UNM); Sierra Blanca ski area, 11300 ft (3444 m), 7 Aug 1977, *Haggren, W. 440* (UNM); Gravel loam of east slope in the White Mts, 7950 ft (2423 m), 30 Jun 1969, *Hutchins, B. 2117* (UNM); Gravel loam of east slope, White Mts, 7950 ft (2423 m), 30 Jun 1969, *Hutchins, B. 2117* (UNM); Sierra Blanca Ski Area, 9000 ft (2743 m), 9 Jul 1977, *Haggren, W. 311* (UNM); 4 mi off of Timberon Rd on Old Sun Spot Rd, 8 Sep 1979, *Whitmore, K. 13* (NMCR); Gilmore Ranch, White Mts, 17 Aug 1908, *Wooton, E.O. s.n.* (NMC); White Mts, 7400 ft (2256 m), 25 Aug 1907, *Wooton E.O. & P. Standley 3570* (NMC); Sierra Blanca Ski Area, 11,300 ft (3444 m), 8 Jul 1977, *Manthey, T. & W. Haggren 1993* (UNM); Sierra Blanca ski area, 10000 ft (3048 m), 7 Aug 1977, *Haggren, W. 403* (UNM). LOS ALAMOS Co.: Pajarito Mts. Mixed conifer, 8250 ft (2515 m), [no collector] *636* (UNM); Bottom Frijoles Canyon, Bandelier Natl. Monument, 1 Aug 1941, *Clark, M.O. 9963* (UNM); Shady bottoms at Frijoles Canyon, 6000 ft (1829 m), 1 Aug 1941, *Clark, O.M. 9963* (UNM); In spruce-fir S. of Upper Frijoles Meadow, 9600 ft (2926 m), 18 Aug 1982, *Dunbar, T. 244* (UNM); Frijoles Canyon Campground, 6000 ft (1829 m), 23 Sep 1939, *Thomas, C.G. 10* (UNM); Upper Frijoles meadow, 9600 ft (2926 m), 18 Aug 1982, *Dunbar, T. 222* (UNM). MCKINLEY Co.: Westfork Peach Spring Canyon, Sandstone, 6700 ft (2042 m), 10 Sep 1976, *Wagner, W.L. 2627* (UNM); Dalton Pass Canyon, upper mesa, 7400 ft (2256 m), 29 Jul 1976, *Marley, G. 89* (UNM); Along bottom of Dalton Pass Canyon, pinyon and Douglas-fir, 2400 ft (732 m), 31 Jul 1976, *Powell, R. 139* (UNM); 7 mi. S of Washington Pass, 8800 ft (2682 m), 3 Aug 1958, *McKnight, A.* (UNM-58080309). OTERO Co.: in the Lincoln Natl. For., 7 mi SW of High Rolls, 29 Aug 1939, , *Bridges, J.O. 1513* (NMCR); Hwy 24, 1/2 mi S of jct hwy 130, 8 Sep 1979, *Allred, K.W. 1705* (NMCR); 4 mi E of Cloudcroft, 9000 ft, 25 Sep 1938, *Bridges, J.O. s.n.* (NMCR); Cloudcroft, Sacramento Mts, 8750 ft (2667 m), 24 Aug 1901, *Wooton, E.O. s.n.* (NMC); Karr Canyon, Sacramento Mts, 3 Aug 1952, *Swallen, J.R. 2704* (UNM). RIO ARRIBA Co.: San Pedro Mts, Santa Fe Natl. Forest, San Gregorio Lake, 9400 ft (2865 m), 19 Sep 1964, *Jennings, D.T. s.n.* (UNM); 2 mi. S of Lake San Gregorio, 25 Jul 1965, *Fleck, A. s.n.* (UNM); S. branch Paleo Creek, San Pedro Park's wild area, 9800 ft (2987 m), 12 Jul 1964, *Fleck, A. 54* (UNM); Vega Redondo Road, E. of forest sign, 12 Aug 1965, *Fleck, A. s.n.* (UNM); San Gregorio, 19 Sep 1964, *Fleck, A. s.n.* (UNM); Cochiti, NE slope, 19 Apr 1964, *Robertson, C.* 7 (UNM); Bare dry hillside, La Cueva, Jemez Mountains, 11 Aug 1931, [no collector] *2715* (UNM); Carson National Forest, just off of hwy 64, about 12 air miles west of Tres Piedras, 7 Sep 1988, *Allred, K.W. 4855* (NMCR); San Pedro Mts. near San Gregorio Lake, 9400 ft (2865 m), 19 Sep 1964, *Fleck A.* (UNM). SAN MIGUEL Co.: Harvey's upper ranch, 9600 ft (2926 m), 1 Aug 1908, *Standley, P.C. 4737* (NMC); West Panchuela R.S., Santa Fe Natl. For., 29 Aug 1937, *Hare, Q.A. s.n.* (NMCR); Meadows along Winsor Creek, Cowles, 8500 ft (2591 m), 8 Sep 1954, *Castetter, E.F. 9422* (UNM); Pecos Wilderness, Forest Rds 645 & 156, between Terrero Mine and summit of Elk Mt, Santa Fe Mts, 19 Aug 1984, *Hill, S.R. 15248* (NMCR); Jack's Creek, 5 mi above Cowles, Jul 1938, *Bridges, J.O. 1425* (NMCR); Roadside at Cowles, 25 Aug 1946, *Springfield, W. 2705* (UNM); Sandstone escarpment, Trujillo Hill, 30 mi. E. of Las Vegas, 1 Sep 1955, *Swallen,*

J.R. 10193 (UNM). SANDOVAL Co.: Sandy outwash near Paliza Creek, 3 mi. N. Ponderosa, 7000 ft (2134 m), 22 Jun 1960, *Martin, W.C. 4205* (UNM); Jemez Biological Camp, Jemez Mts., 7100 ft (2164 m), 25 Aug 1931, *Castetter, E.F. 2720, 2722* (UNM); Alamo Canyon, Bandelier Natl. Monument, 6100 ft (1859 m), 31 Aug 1975, *Halley, R. 75* (UNM); Bandelier Natl. Monument, Capulin Canyon Trail, 1/4 mi N of Base Camp, 3 Jul 1983, *Salazar, R.A. 21* (NMCR); Among large spruce and corkbark fir, on medium to deep soil on limestone, 10500 ft (3200 m), 7 Aug 1963, *Naylor, J. 148* (UNM); Bandelier Natl. Monument, 1977 Acquisition, 10 mi NW of Bandelier Natl. Monument entrance station, along Rd 4 at S side of hwy, 10 Aug 1983, *Salazar, R.A. 49* (NMCR). SANTA FE Co.: Chupadero Canyon, Oak zone, 9600 ft (2926 m), 25 Jul 1961, *Dixon, C.K. 183* (UNM); Arroyo Hondo, Santa Fe Forest, gravel woodland, 7100 ft (2164 m), 10 Sep 1960, *Stephenson, J.E. 30* (UNM); North Fork Tesuque Creek, 10920 ft (3328 m), 18 Aug 1973, *Moir, W.H. 228* (NMC). SIERRA Co.: San Mateo Mts., Barney Park, 8020 ft (2444 m), 23 Aug 1978, *Moir, W.H. & E.L. Fitzhugh 681* (NMC); Gallinas Planting Station, July 1908, *Standley, P.C.* (NMC). SOCORRO Co.: Milo Canyon, San Mateo Mts, 8900 ft (2713 m), 27 Aug 1979, *Moir, W.H. & E.L. Fitzhugh s.n.* (NMC); Milo Canyon, San Mateo Mts, 8630 ft (2630 m), 27 Aug 1978, *Moir, W.H. & E.L. Fitzhugh 749* (NMC); Abandoned mine near the end of the road in a canyon 5-6 mi. S of Magdalena, 8000 ft (2438 m), 3 Oct 1948, *Dunn, D. 5116* (UNM); Magdalena Mts. East slope of Water Canyon, 8000 ft (2438 m), 10 Sep 1959, *Martin, W.C. 3660* (UNM); Roadside among aspens, north slope of Mt. Withington, 9600 ft (2926 m), 11 Jul 1952, *Castetter, E.F. 2710* (UNM); Willow Creek, 7 Sep 1936, *Parker, K.W. 882* (NMCR); Magdalena Mts, Water Canyon, open grassland, 8000 ft (2438 m), 3 Oct 1964, *Vickery, L. 13* (UNM); Roadside among aspens, north slope of Mt. Withington, 9600 ft (2926 m), 11 Jul 1952, *Castetter, E.F. 2708* (UNM); Water Canyon, Magdalena, Summer 1897, *Wooton, E.O. 332* (UNM); 2 mi. W of Rosedale in a clearing on the forest floor, 7750 ft (2362 m), 28 Aug 1948, *Dunn & Lint 4676* (UNM). TAOS Co.: Cabresto Creek Canyon, 9350 ft (2850 m), 21 Jul 1973, *Moir, W.H. 98* (NMC); Carson Forest, Aug 1960, *Engstrom, G.E. 3* (UNM); Costilla Creek, Sangre de Cristo Mts, 8500 ft (2591 m), 15 Aug 1973, *Holmgren, N.H. & P.K. Holmgren 7178* (NMC); Sangre de Cristo Mts, Carson Natl. Forest, Frazier Mt, July 1989, *Warren, A. s.n.* (NMCR); Carson Forest, 29 Aug 1960, *Blanchard, R.L. 29* (UNM); Sangre de Cristo Range, rocky slopes, 6 Jul 1966, *Weeks, M.C. 15* (UNM); Creek bottoms, east of Questa, 8 Aug 1951, *Clark, M. s.n.* (UNM). TORRANCE Co.: Manzano Mts, Kaiser Mill Canyon, mixed hardwood conifer assoc, 8400 ft (2560 m), 18 Aug 1962, *Bedker, E.J. 589* (UNM); Manzano Mts. Red Canyon W. of Red Canyon Camp, 8000 ft (2438 m), *Bedker, E.J. 1286* (UNM); Manzano Mts, lower 1 mi. part of De La Vereda Canyon, 7600 ft (2316 m), 28 Jul 1962, *Bedker, E.J. 248* (UNM); Manzano Mts, along crest 1/2 mi. N of Manzano Creek, conifer assoc., 9900 ft (3018 m), 18 Aug 1962, *Bedker, E.J. 706* (UNM).

Bromus frondosus: BERNALILLO Co.: Albuquerque ECW District, 8000 ft (2438 m), 11 Nov 1936, *Greenwall 157* (UNM). CATRON Co.: Middle Fork Gila River, Mogollon Mts, 7120 ft (2170 m), 10 Sep 1978, *Moir, W.H. & E.L. Fitzhugh 590* (NMC); Gila Natl. For., Luna District, For Rd 19, about 2 mi N of Luna,

11 Sep 1982, *Allred, K.W. 2332, 2372* (NMCR); 40 mi NW of Pietown, 27 Aug 1936, *Parker, K.W. 852, 853* (NMCR); Snow Lake Road, junction with Reserve-Beaverhead road, Mogollon Mts, 8400 ft (2560 m), 8 Sep 1978, *Moir, W.H. & E.L. Fitzhugh 715* (NMC); Datil Mts, sandy arroyos, 7600 ft (2316 m), 10 Jul 1976, *Fletcher 463* (UNM). CIBOLA Co.: Zuni Mts, 7800 ft (2377 m), 17 Aug 1968, *Riffle, N.L. s.n.* (UNM); Mt. Taylor, La Mosca Lookout, 19 Jul 1961, *Osborn, N. 695* (UNM). DONA ANA Co.: Craters, 6000 ft (1829 m), 28 Jul 1906, *Wooton, E.O. s.n.* (NMC); Filmore Canyon, Organ Mts, 23 Sep 1906, *Wooton, E.O. s.n.* (NMC); E side of Organ Mts on the College area, 29 Jul 1940, *Bridges, J.O. 1558* (NMCR); Indian Hollow, N end of Organ Mts, 28 Sep 1935, *Anderson, S.E. 94* (NMCR); Dripping Springs, Boyd ranch, Organ Mts, 6000 ft (1829 m), 21 Oct 1950, *Dunn, D.B. 7231* (UNM); Box Canyon off Soledad, 11 Sep 1904, *Wooton, E.O. s.n.* (NMC); Organ Mts, 6000 ft (1829 m), 23 Sep 1906, *Wooton E.O. & P. Standley s.n.* (NMC). EDDY Co.: Guadalupe Ridge near large cave, 7200 ft (2195 m), 14 Sep 1916, *Chapline, W.R. 692* (NMC). GRANT Co.: along road from San Lorenzo to Hillsboro, about 5 miles east of San Lorenzo, 5 Aug 1988, *Allred, K.W. 4806* (NMCR); Kneeling Nun, 1/4 mi. E of Mimbres Mts, 7 Sep 1985, *Spellenberg R., N. Zucker, & R. Soreng 8288* (NMC); Gila National Forest, Hwy 90 roadside, 6000 ft (1829 m), 8 Aug 1976, *Wagner, W.L. 2342* (UNM). HIDALGO Co.: Post Office Canyon SE of Rodeo, 5600 ft (1707 m), 12 Sep 1977, *Moir, W.H. 707* (NMC); Animas Mts, Lower Indian Creek Canyon, 5750 ft (1752.6 m), 22 Jul 1975, *Wagner, W. 1163* (UNM); West Fork Indian Creek Canyon, Animas Mts, 7000 ft (2134 m), 6 Aug 1976, *Wagner, W.L. 2263* (NMC); Animas Mts, Lower Indian Creek Canyon, 5800 ft (1767 m), 6 Aug 1976, *Wagner, W.L. 2245* (UNM); Cloverdale, at intersection of roads, 6 Aug 1987, *Sherman, J. s.n.* (NMCR); Peloncillo Mts, along Geronimo Trail, 5 Sep 1987, *Allred, K.W. 4580* (NMCR); Peloncillo Mts, Coronado National Forest, Skeleton Canyon, about 1/4 mile east of Arizona state line, 15 Sep 1989, *Allred, K.W. 5029* (NMCR); Gray Ranch, east slopes of Animas Mt, unknown canyon bottom, 26 Oct 1990, *Allred, K.W. 5182* (NMCR); Clanton Draw, Coronado Natl. For. near the entrance to forest lands, 5 Sep 1987, *Allred, K.W. 4575* (NMCR); Guadalupe Canyon, Guadalupe Mts, 22 Aug 1956, *Castetter, E.F. 11215* (UNM); Peloncillo Mts, Coronado Natl. Forest, Clanton Draw, 19 Aug 1986, *Allred, K.W. 4168, 4169, 4175* (NMCR); Peloncillo Mts, along Geronimo Trail, 5 Sep 1987, *Allred, K.W. 4581* (NMCR). LINCOLN Co.: Lincoln Natl. For., Forest Rd 108, 2 Sep 1983, *Allred, K.W. 2557* (NMCR). LOS ALAMOS Co.: Water Canyon, Pistol Range, 6500 ft (1981 m), 11 Jun 1978, *Foxx & Tierney 21* (UNM). MORA Co.: Sapello, 2 mi. north, 22 Sep 1954, *Williams, E. 9424* (UNM). OTERO Co.: Karr Canyon, Sacramento Mts, 3 Aug 1952, *Castetter, E.F. 8364* (NMC); Between Weed and Sacramento, 12 Aug 1970, *Correll D.S. & H.B. Correll 39232* (NMC); White Mts, South Fork Eagle Creek, 31 Jul 1897, *Wooton, E.O. s.n.* (UNM); Mayhill, Lincoln Forest Experimental Area, 6800 ft (2072 m), Oct 1960, *Hoyer, R.C. 27* (UNM). RIO ARRIBA Co.: Carson National Forest, *Brown, D. s.n.* (UNM); Santa Fe National Forest, Jarosa, 9000 ft (2743 m), 25 Aug 1960, *Romero, E. 22* (UNM). SAN MIGUEL Co.: near Cowles, 3 Aug 1938, *Mocho, P. 1746* (NMCR). SANDOVAL Co.: Jemez Mts, Monument Canyon, ponderosa

pine, 8200 ft (2499 m), 22 Sep 1983, *Fletcher, R. 7455* (UNM). SOCORRO Co.: Rosedale, 2 mi. west, 7750 ft (2362 m), 29 Aug 1948, *Dunn, D. & Lint 4743* (UNM); Rosedale Rd. & hwy. 107, 5 mi. north in rocky gorge, 29 Aug 1948, *Dunn D. s.n.* (UNM); South of Magdalena along stream bed, 7500 ft (2286 m), 10 Mar 1948, *Dunn, D. 5147* (UNM); Mogollon Creek, Mogollon Mts, 8000 ft (2438 m), 27 Jul 1903, *Metcalfe, O.B. 325* (NMC); Rosedale, abandoned gold mine, open forest and meadow, 7200 ft (2195 m), 29 Aug 1948, *Dunn, D. 4748* (UNM); Magdalena Mts, dry stream in South Canyon, 6800 ft (2073 m), 25 Aug 1973, *Hutchins, B. 4650* (UNM); Forest Road 330, San Mateo Mts, 9330 ft (2844 m), 27 Aug 1978, *Moir W.H. & E.L. Fitzhugh 700* (NMC); 5 mi W of Willow Creek, 8 Sep 1936, *Parker, K.W. 884* (NMCR); Magdalena Mts, ridge between Timber Peak and South Baldy, 9000 ft (2743 m), 11 Sep 1959, *Martin, W.C. 3717* (UNM); Milo Canyon, San Mateo Mts, 8780 ft (2676 m), 27 Aug 1978, *Moir W.H. & E.L. Fitzhugh 748* (NMC).

Bromus lanatipes: BERNALILLO Co.: Sandia Park, Sandia Peak, 7575 ft (2309 m), 5 Aug 1949, *Gordon, S. & K. Norris 21, 65* (UNM); Sandia Mts, 24 Sep 1897, *Herrick, C.L. s.n.* (NMC); South of Sedillo Hill, 7300 ft (2225 m), 10 Oct 1980, *Fletcher, R. 5147* (UNM). CATRON Co.: Rocks along arroyo 4 mi. SW of Datil on Route 12, 6 Aug 1952, *Roller, J.W. & E.F. Castetter 2699* (UNM); Datil Mountains, volcanic soil, 8500 ft (2591 m), 18 Sep 1976, *Fletcher, R. 1618* (UNM). CIBOLA Co.: Base of cliff, Canyon de Califia, 7700 ft (2347 m), 24 Sep 1977, *Marley, G.A. 862* (UNM); Inscription Rock Natl. Mon. at base of cliff, 26 Aug 1936, *Parker, K.W. 839* (NMCR); 3 mi N of Datil, Sep 1939, *Bridges, J.O. 1732* (NMCR); El Morro Natl. Monument, Sandfilled cracks on Inscription Rock, 7200 ft (2195 m), 27 Sep 1980, *McCallum, D.A. 938* (UNM); El Morro National Monument, under ponderosa, 7200 ft (2195 m), 30 Oct 1980, *McCallum, D.A. 967* (UNM); Zuni Canyon, Zuni Mts, 7400 ft (2256 m), 10 Aug 1968, *Riffle, N.L. s.n.* (UNM); Craters, 28 Jul 1906, *Wooton, E.O. s.n.* (NMC); Inscription Rock, 7000 ft (2134 m), 27 Aug 1936, *Gardner, J.L.* (NMC); Grants Lava Flow, growing in damp depression with shrubs, 7000 ft (2134 m), 27 Jul 1986, *DeBruin, E. 449* (UNM). COLFAX Co.: 15 mi SE of Cimarron on Vallejo Ranch, 6 Oct 1977, *Gould, F.W. 15325* (NMCR). DONA ANA Co.: V. Pasture, 23 Jul 1905, *Wooton, E.O. s.n.* (NMC); Dripping Springs, Organ Mts, 29 Sep 1935, *Parker, K.W. 725* (NMCR). HIDALGO Co.: SE of Rodeo, Owl Canyon, 5500 ft (1676 m), 9 Aug 1977, *Moir, W.H. 774* (NMC); Animas Mtns, Upper Indian Creek Canyon, 7000 ft (2134 m), 4 Oct 1975, *Wagner, W. 1721* (UNM); Mexican Springs upper area, 7500 ft (2286 m), 28 Aug 1936, *Gardner, J.L. s.n.* (NMC); Animas Mtns, Upper Indian Creek Canyon, 6300 ft (1920 m), 13 Sep 1975, *Wagner, W. 1541* (UNM); Peloncillo Mts, Cloverdale Creek, public land southeast of Pendleton Ranch, Forest Service cabin, 6 Aug 1987, *Sherman, J. s.n.* (NMCR). LINCOLN Co.: Fort Stanton, E pasture (ungrazed section), 12 Sep 1980, *Lebgue 396* (NMCR); White Mts. NW slope, gravel loam, 7200 ft (2195 m), 24 Oct 1969, *Hutchins, B. 2703* (UNM); Gray, 6250 ft (1905 m), July 1900, *Earle, F.S. & E.S. Earle 162* (NMC); White Mts. North Fork of Eagle Creek, partial shade, 8800 ft (2682 m), 22 Jul 1981, *Ward, D. 81-22* (NMC); Capitan Mts, douglas fir-ponderosa pine-white fir, 2300 m, 1 Aug 1976, *Wagner, W.L. & D. Sabo 2169* (UNM). LUNA Co.: along bank of drainage on slope of Cooke's Peak, 29 Aug 1987, *Columbus, J.T.*

1712 (NMCR); along small stream in bottom of Rattlesnake Canyon; near small metal watertank, 21 Aug 1987, *Columbus, J.T. 1583* (NMCR); Just below ridgetop at base of large wall-like rock outcrop some 15 ft tall, 30 Jul 1986, *Columbus, J.T. 344* (NMCR). MCKINLEY Co.: Mountain Valley Navajo Experiment Station, 7500 ft (2286 m), 28 Aug 1936, *Gardner s.n.* (NMC); Upper Dalton Pass Mesa, sandy soil among rocks at canyon edge, 7400 ft (2256 m), August 1976, *Marley, G. 129* (UNM); Head of Running Edge Canyon, 7200 ft (2195 m), 24 Jul 1976, *Powell, R. 127, 129* (UNM); Dalton Canyon, surrounding disturbed drill site, sand and sandstone, pinyon-juniper and *Cowania*, 7200 ft (2195 m), 31 Jul 1976, *Powell, R. 140* (UNM); Burning Bridge Wash, 4 mi. SW of Pueblo Pintado Trading Post, 6700 ft (2042 m), 10 Aug 1976, *Spellenberg, R., J. Reitzel, & H. McKinney 4321* (NMC). OTERO Co.: Mayhill, 27 Oct 1936, *Goodding, L.N. & E.W. Hardies 867* (NMC). QUAY Co.: Mosquero, 20 mi. west, 28 Jul 1942, *Bradford, H.W. s.n.* (NMC). SAN MIGUEL Co.: Mesita de Los Ladrones, sandstone rim, lower end of pinyon-juniper, 16 Sep 1982, *Fletcher, R. 6773* (UNM). SANDOVAL Co.: Lower Jemez Canyon roadside, Jemez Mts, 7500 ft (2286 m), 12 Aug 1931, *Castetter, E.F. 2716* (UNM). SIERRA Co.: North Percha Creek, 6000 ft (1829 m), 12 Aug 1904, *Metcalfe, O.B. 1131* (NMC,UNM). SOCORRO Co.: 6 Mile Canyon, 14 Aug 1949, *Fleetwood, R.J. 9710* (UNM); Ladron Mts. along Canyon del Alamito, arroyo, 6800 ft (2073 m), 15 Aug 1965, *Baca, O. 275* (UNM); Water Canyon, E of South Baldy Peak, 8300 ft (2530 m), 12 Oct 1955, *Potter, L.D. 239* (UNM); Magdalena Mts, Water Canyon, 3 mi from mouth, 10 Jul 1940, *Bridges, J.O. 1656* (NMCR); Vicinity of Water Canyon, Magdalena Mtns, 7475 ft (2278 m), 27 Jul 1973, *Hutchins, B. 4310, 4436, 4512, 4528* (UNM); Gravel loam of stream area in South Canyon, Magdalena Mts, 8000 ft (2438 m), 28 Jul 1973, *Hutchins, B. 4602* (UNM); Ladron, in ponderosa stand at head of Canyon del Norte, 6850 ft (2088 m), 2 Oct 1975, *Manthey, T. 670* (UNM); Grand Cañon, East Fork of Gila, 6000 ft (1829 m), 19 Aug 1900, *Wooton, E.O. s.n.* (NMC); Gravel loam of dry stream area, South Canyon, Magdalena Mts, 6800 ft (2073 m), 25 Aug 1973, *Hutchins, B. 4648* (UNM). TAOS Co.: 2 mi. E of Valdez, riparian habitat, 22 Aug 1966, *Robinson & McLean 40* (UNM); Huerfano, south facing fields, 8500 ft (2591 m), 8 Jul 1967, *Mackay, H. 5-23* (UNM); Rich soil, disturbed, grazed, Kit Carson State Park, 6952 ft (2119 m), Nov 1966, *Jones, C.B. 54-11* (UNM). TORRANCE Co.: Manzano Mtns, Priest Canyon, pinyon-juniper association, 7000 ft (2134 m), 1 Sep 1963, *Bedker, E.J. 1439* (UNM).

Bromus porteri: BERNALILLO Co.: Sandia Crest, 20 Jul 1936, *Carter, C.B. s.n.* (NMC). CATRON Co.: Apache National Forest, 14 Oct 1960, *Bilbrey, D. 27* (UNM); 5 mi S of Mogollon, 7 Sep 1936, *Parker, K.W. 973* (NMCR); Datil Mts, sandstone soil, 7300 ft (2225 m), 10 Aug 1976, *Fletcher 936* (UNM); Datil Mts, volcanic soil, bog area, 8000 ft (2438 m), 10 Jul 1976, *Fletcher 540* (UNM); Apache National Forest, 19 Aug 1960, *Laney, V.F. 19* (UNM); Datil Mts, volcanic soil, bog area, 8000 ft (2438 m), 10 Jul 1976, *Fletcher 540* (UNM); Gila Natl. For., Flannagan Cienega, For Rd 220, 11 Sep 1982, *Allred, K.W. 2347* (NMCR). CIBOLA Co.: Just below Mt. Taylor Peak, 11000 ft (3353 m), 18 Aug 1961, *Osborn, N. 893* (UNM); Mt. Taylor, 22 Aug 1965, *Barnett, L. 13* (UNM); Pescado Spa, 2 Aug 1892, *Wooton, E.O. s.n.* (NMC); Just below Mt. Taylor Peak, 11000 ft (3353 m), 10 Aug 1960,

Osborn, N. 512 (UNM); North of Ramah, 25 Jul 1906, *Wooton, E.O. s.n.* (NMC). GRANT Co.: Gila Natl. For., hwy 90, Emory Pass vista, 2 Oct 1982, *Gallegos, M. 32* (NMCR); Graveyard at Kingston, *Bridges, J.O. 1919* (NMCR). LINCOLN Co.: Lincoln Natl. For., For Rd 108, 2 Sep 1983, *Allred, K.W. 2553* (NMCR); White Mountains, mountain north of Sierra Blanca Ski Lodge, 9 Oct 1987, *Allred, K.W. 4663* (NMCR); Skyline Picnic Area, White Mts, 9000 ft (2743 m), 26 Oct 1968, *Hutchins, B. 1759* (UNM). LOS ALAMOS Co.: Upper Frijoles Meadow, 9600 ft (2926 m), 19 Jul 1982, *Dunbar, T. 102* (UNM); White Rock in Pajarito Canyon, juniper-grassland, 29 Aug 1979, *Foxx & Tierney 635* (UNM). MORA Co.: [no locality], 11360 ft (3463 m), August 1982, *Andrews, T. 133* (UNM). OTERO Co.: Gilmore Ranch, Eagle Creek, White Mts, 12 Aug 1897, *Wooton, E.O. 3321* (UNM); Monjeau Lookout, Sierra Blanca, 10000 ft (3048 m), 17 Aug 1952, [no collector] *2698* (UNM). RIO ARRIBA Co.: 3 mi NW of Chama (private land), 22 Aug 1940, *Bridges, J.O. 2149* (NMCR); El Vado Dam, 14 Jun 1936, *Carter, C.B. s.n.* (NMC); Carson National Forest, 24 Jul 1960, *Hutt, J.F. 27* (UNM); Carson National Forest, 12 Jul 1960, *Eby, J.W. 17* (UNM). SAN JUAN Co.: Whiskey Lake, Chuska Mts, 8600 ft (2621.28 m), August 1934, *Shirley, W.D. 21* (NMC); Crystal, western flanks of Chuska Mts, ponderosa pines, 8000 ft (2438 m), 30 Jul 1958, *McKnight, A. s.n.* (UNM); Whiskey Lake Region, Chuska Mts, 8500 ft (2590.8 m), 22 Jul 1935, *Carter, C.B. 8244* (NMC). SAN MIGUEL Co.: Harvey's Upper Ranch, 9600 ft (2926 m), 1 Aug 1908, [no collector] *4738* (NMC); Panchuela Creek, 8800 ft (2682 m), 4 Jul 1908. [*Standley, P.C.?*] *4186* (NMC); Jack's Creek, 5 mi above Cowles, Jul 1939, *Bridges, J.O. 1380* (NMCR); Pecos Wilderness, For. Rds. 645 & 156, between Terrero Mine and Summit of Elk Mt, Santa Fe Mts, 19 Aug 1984, *Hill, S.R. 15314* (NMCR); Ridge 5 mi above Cowles, Jul 1939, *Bridges, J.O. 1362* (NMCR). SANDOVAL Co.: Jemez Mts, hwy 4, about 3 mi W of Berlandier Natl. Monument boundary, 11 Aug 1983, *Allred, K.W. 2543* (NMCR). SANTA FE Co.: Santa Fe, 5 Oct 1960, *Weissenborn, K.R. 32* (UNM); Lower Canoncito, about 8 air mi SE of Santa Fe, 8 Aug 1985, *Allred, K.W. 3016* (NMCR); Near Otowi ruins, 6700 ft (2042 m), 18 Jul 1938, *Spuhler 9* (UNM). SIERRA Co.: 17 mi NW Winston, 6 Sep 1936, *Parker, K.W. 912* (NMCR). SOCORRO Co.: Meadow top of Mt. Withington, 11 Jul 1952, [no collector] *2697* (UNM). TAOS Co.: Along banks of East Fork of Red River, 9600 ft (2926 m), 5 Aug 1980, *Fletcher, R. 4733* (UNM); Sagebrush-pinyon-juniper community among large basaltic outcrops, about 3 mi E of Hwy 285 along Hwy 96 to Carson, 7 Aug 1986, *Allred, K.W. 4097* (NMCR); Mouth of Saw Mill Fork, Carson Forest, Questa, 10000 ft (3048 m), 24 Jan 1933, *Nelson, A. 2721* (UNM).

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BOOKS RECEIVED

Crop Ecology: Productivity and Management in Agricultural Systems. R.S. Loomis & D.J. Connor. Cambridge University Press, 40 West 20th Street, New York, New York 10011-4211. 1992. xiv. 538 pp. $100.00 (hardcover); $39.95 (paper). ISBN 0-521-38379-X (hardcover); 0-521-38776-0 (paper).

This book takes a comprehensive view of agricultural systems, examining infrastructural, economic, and other anthropogenic factors of the agricultural environmental as well as biological and physico/chemical parameters affecting crop production. Major sections include summaries of agricultural systems (general introduction, agricultural communities, stability of agricultural systems, genetic resources, and development of new agricultural systems), influences of air and soil on crop production, physiological factors (nitrogen, water, photosynthesis, and respiration) affecting production, and a final section on resource management (soils, water, energy, crop combinations, and planning for the future).

The Evening Garden, Flowers and Fragrance from Dusk till Dawn. Peter Loewer. MacMillan Publishing Co., 866 Third Avenue, New York, New York 10022. 1993. xvi. 256 pp. $25.00 ($31.95 in Canada) (hardcover). ISBN 0-02-574041-5.

This is an interesting book, detailing plants which might be found in a garden to be enjoyed after dark. Many of the plants flower only or primarily at night, while other have flowers that are open during the day, but remain open at night. Considerable information is contained on plants that produce strong scents at night. In addition to plants, some photoluminescent fungi are included, as well as animals that might be observed in a garden at night.

Plant Organelles, Compartmentation of Metabolism in Photosynthetic Tissue. Alyson K. Tobin (ed.). Society for Experimental Biology Seminar Series 50. Cambridge University Press, 40 West 20th Street, New York, New York 10011-4211. 1992. xviii. 332 pp. $89.95 (hardcover). ISBN 0-521-40171-2.

A total of 43 authors contributed fourteen papers to this volume which provides a review of current knowledge on organelles. Topics examined include interactions between organelles, regulation of metabolic activity in organelles, and synthesis. Many of the papers discuss metabolic systems in plants with differing photosynthetic pathways (CAM, C_3, C_4). Most of the papers are targeted to chloroplast physiology.

Plant Resistance to Herbivores and Pathogens, Ecology, Evolution, and Genetics. Robert S. Fritz & Ellen L. Simms (eds.). The University of Chicago Press, 5801 Ellis Avenue, Chicago, Illinois 60637. 1992. x. 590 pp. $75.00 (cloth); $29.95 (paper). ISBN 0-226-26553-6 (cloth); 0-226-26554-4 (paper).

Four major sections in this book examine analysis and inheritance of resistance, evolutionary responses by herbivores and pathogens to plant resistance, plant resistance variation on population and community levels, and evolution of plant resistance. Eighteen papers were contributed by twenty authors.

The Survival World of Birds. John Gooders, foreword by Allan R. Keith. McGraw-Hill, Inc., 11 West 19th Street, New York, New York 10011. 1993. 224 pp. $39.50 (hardcover). ISBN 0-07-023960-6.

This wonderfully illustrated book, in addition to being enjoyable to browse, could be an excellent teaching tool to convey concepts of evolution and biogeography. The numerous color photographs are accompanied by captions and text which lead the reader into fundamental questions on these topics. While by-and-large, the questions are not answered in the book, they are raised in the context of a group of organisms (birds) to which much of the general public can relate. The primary organization of the book is to consider birds on a continent by continent basis (*i.e.*, chapters on Africa, North America, South America, etc.).

Information for Authors

Articles from botanical systematics and ecology, including biographical sketches, critical reviews, and summaries of literature will be considered for publication in PHYTOLOGIA. Manuscripts may be submitted either on computer diskette, or as typescript. Diskettes will be returned to authors after action has been taken on the manuscript. Diskettes may be 5.25 inches or 3.5 inches and may be written in any IBM or MacIntosh compatible format. Typescript manuscripts should be single spaced and will be read into the computer using a page scanner. The scanner will read standard typewriter fonts but will not read dot matrix print. Manuscripts submitted in dot matrix print cannot be accepted. Use underscore (not italics) for scientific names. Corrections made on typescript manuscripts must be complete and neat as the scanner will not read them otherwise. Language of manuscripts may be either English or Spanish. Figures will be reduced to fit within limits of text pages and therefore, should be submitted with an internal scale and have dimensions proportional to those for text pages. Legends for figures should be included in figures whenever possible. Each manuscript should have an abstract and key word list. Specimen citations should be consistent throughout the manuscript. Serial titles should be cited with abbreviations used in *Botanico Periodicum Huntianum*. References cited only as part of nomenclatural summaries should not appear in Literature Cited. Nomenclatural work should include one paragraph per basionym and must provide proper (as defined by the current *International Code of Botanical Nomenclature)* citation of sources of epithets and combinations.

Authors should arrange for two workers in the appropriate field to review the manuscript before submission. Copies of reviews should be forwarded to the editor with the manuscript. Manuscripts will not be published without review.

Cost of publication is currently $13.00 US per page for publication without reprints. Publication with 100 reprints is provided for $18.00 US per page, 200 reprints for $21.50 US per page. Page charges are due with manuscript and no paper will be published before payment is received in full. Reprints must be ordered and paid for in advance. Page charges will be determined on the basis of a typescript page (single spaced, 10 points, blank line between paragraphs) with all type inside a rectangle 143 mm (horizontal) by 219 mm (vertical), not including running head and page number. Title page should include title, author(s) name(s), and address(es). Two blank lines should appear above and below section headings (Abstract, Discussion, Literature Cited, etc.) in the manuscript. No extra charge is made for line drawings provided they conform to limitations of size and proportion for normal text. Halftones require an extra charge of $10.00 US per page.